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(54) SYSTEM AND METHOD FOR AUTOMATED PRINTER DIAGNOSTICS

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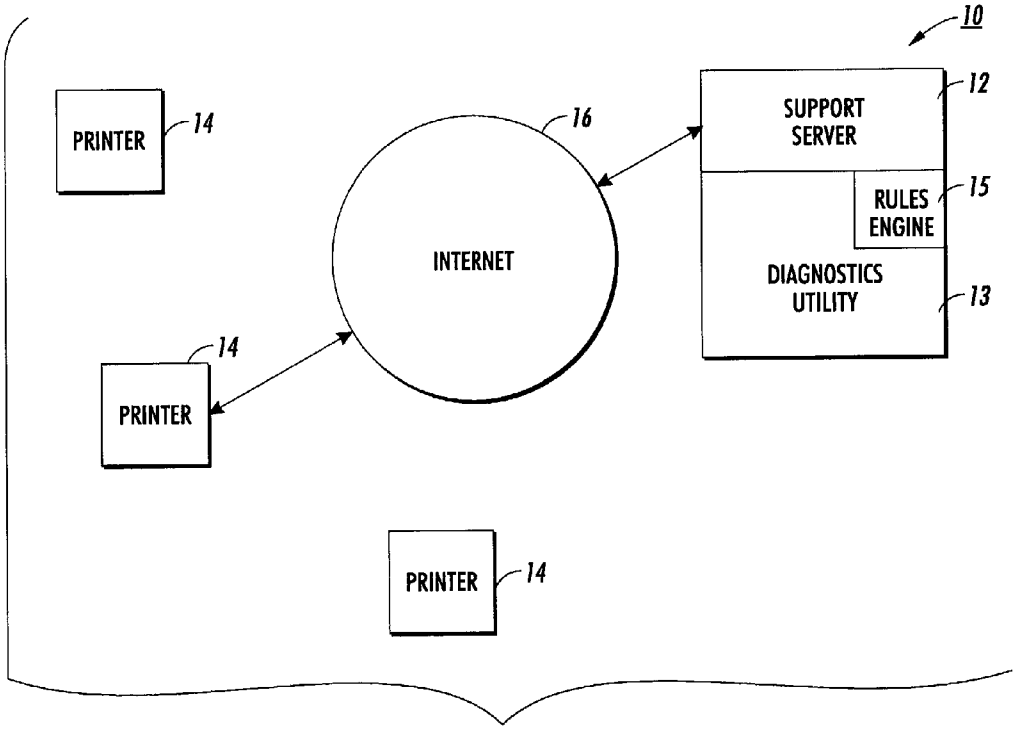
(57) ABSTRACT

A support system for diagnosing printer problems, includes a support server and a printer located remote from the support server. The support server includes a rules engine for parsing printer diagnostic data into components, for analyzing the components and for generating a suggested solution based on combinations of printer diagnostic data and error conditions. The printer includes a printer driver, responsive to a user request for support, for communicating with the support server. Printer diagnostic data may be generated by a usage profile utility resident at the printer or by downloading a printer diagnostic utility from the support server, or a combination of both. Generated printer diagnostic data is sent to the support server where the rules engine parses and analyzes the received data and generates a suggested solution for transmission to the printer.



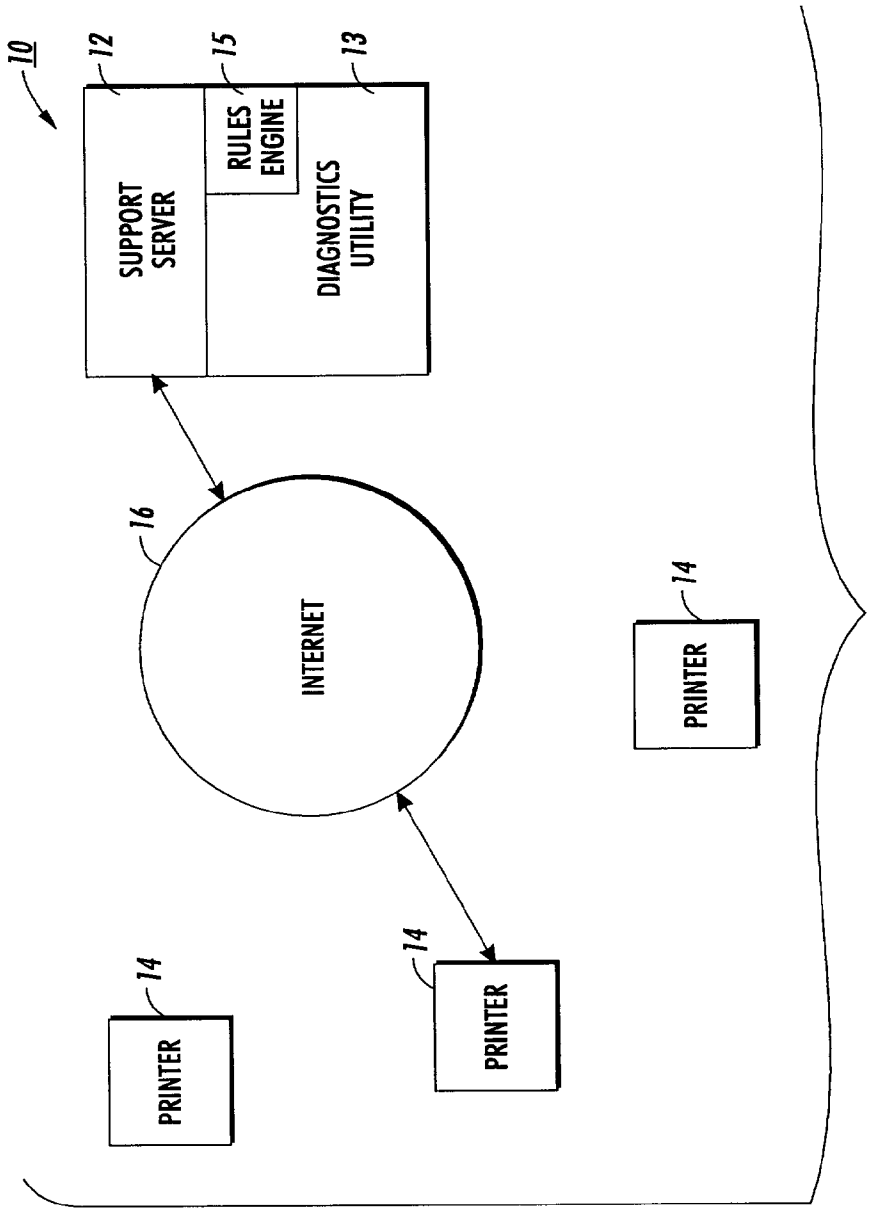

10
12
15
13
SUPPORT SERVER
RULES ENGINE
DIAGNOSTICS UTILITY
16
INTERNET
14
PRINTER
14
PRINTER
14
PRINTER

FIG. 1

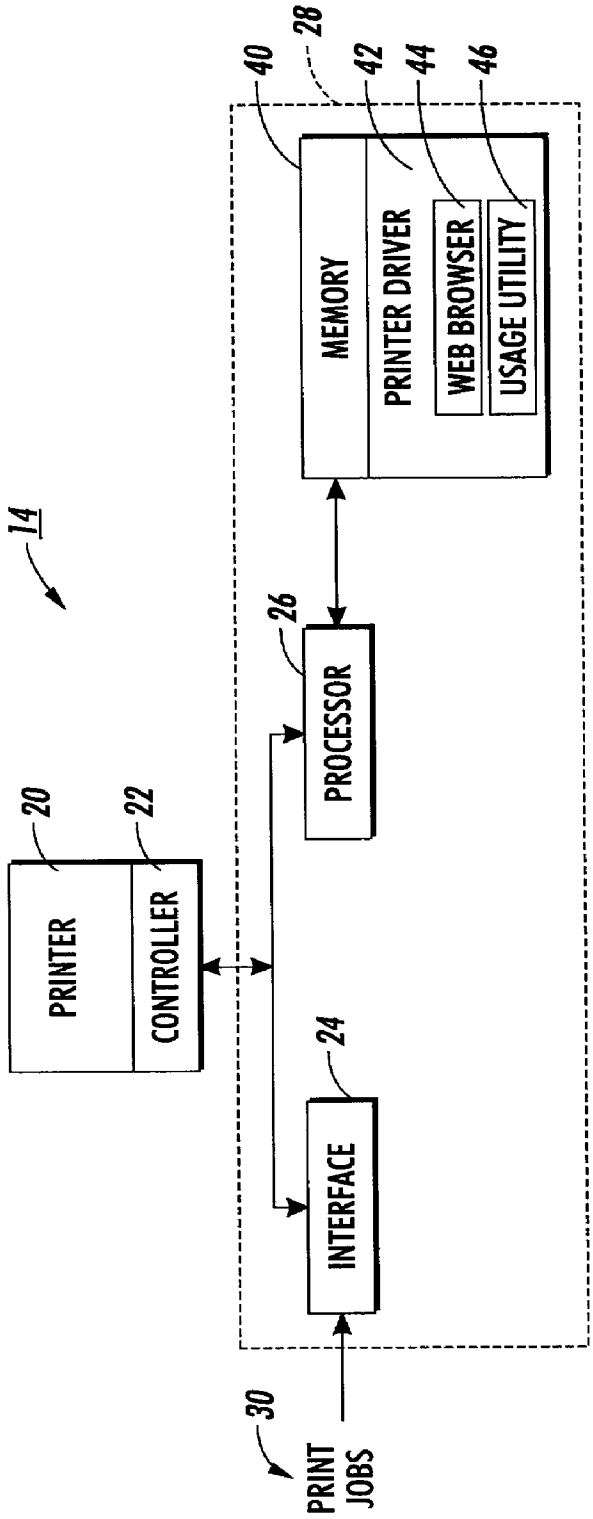

14
28
40
42
44
46
MEMORY
PRINTER DRIVER
WEB BROWSER
USAGE UTILITY
26
PROCESSOR
20
22
PRINTER
CONTROLLER
24
INTERFACE
30
PRINT JOBS

FIG. 2

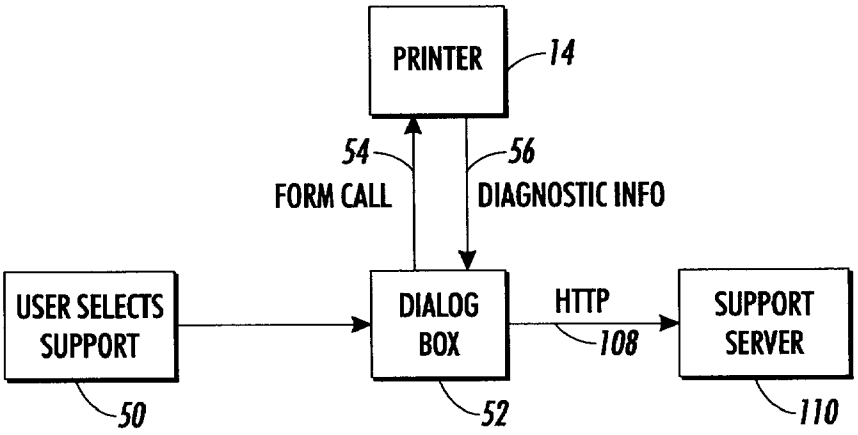

PRINTER
14
54
FORM CALL
56
DIAGNOSTIC INFO
USER SELECTS SUPPORT
50
DIALOG BOX
52
HTTP
108
SUPPORT SERVER
110

FIG. 3

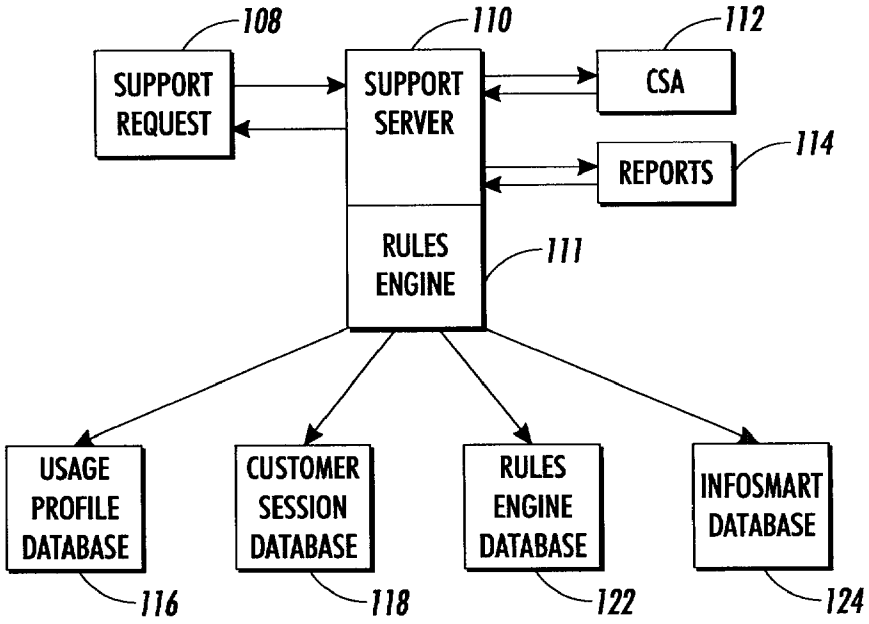

108
SUPPORT REQUEST
110
SUPPORT SERVER
112
CSA
REPORTS
114
RULES ENGINE
111
USAGE PROFILE DATABASE
116
CUSTOMER SESSION DATABASE
118
RULES ENGINE DATABASE
122
INFOSMART DATABASE
124

FIG. 4

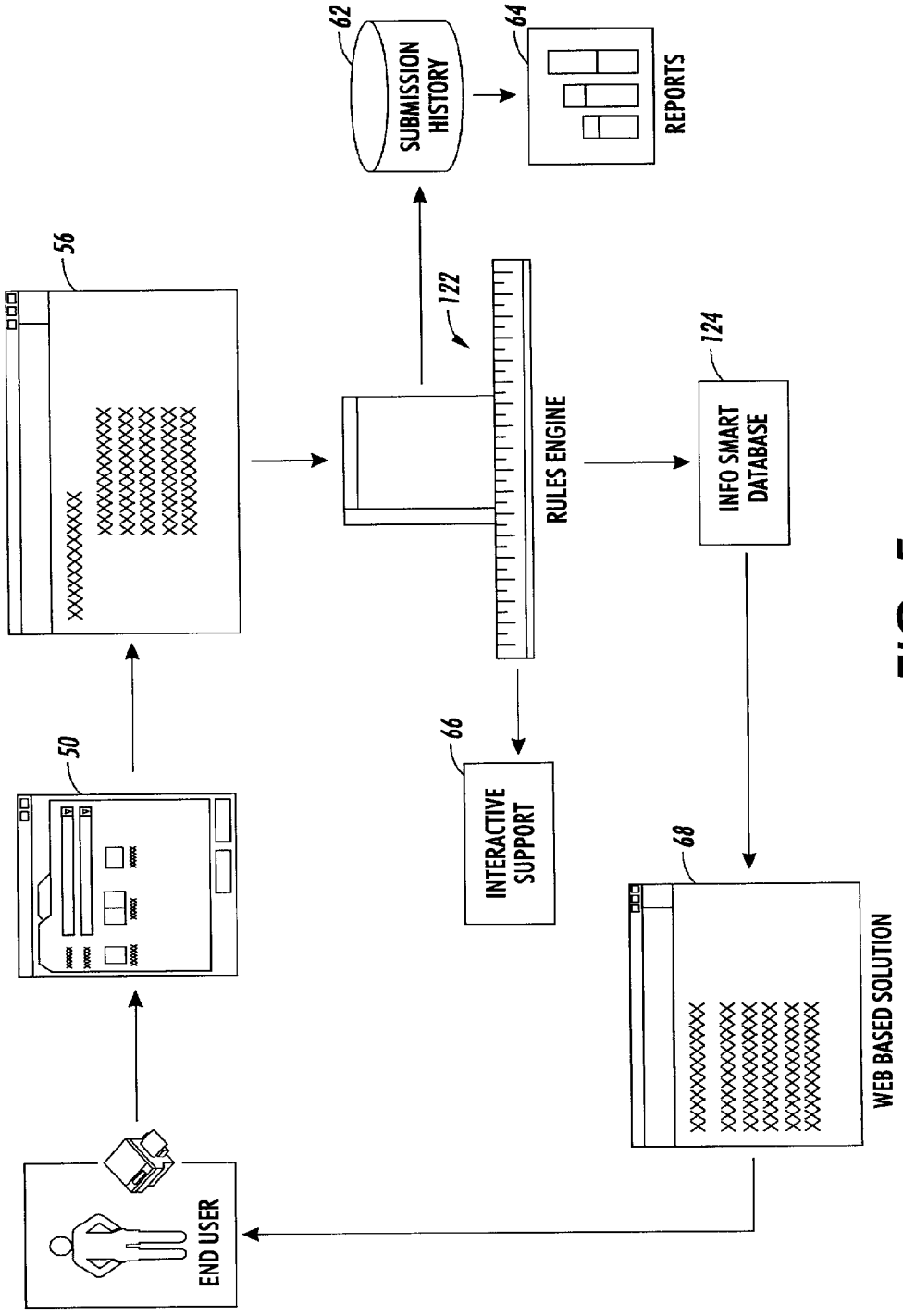

62
SUBMISSION HISTORY
64
REPORTS
56
122
RULES ENGINE
124
INFO SMART DATABASE
50
66
INTERACTIVE SUPPORT
68
WEB BASED SOLUTION
END USER

FIG. 5

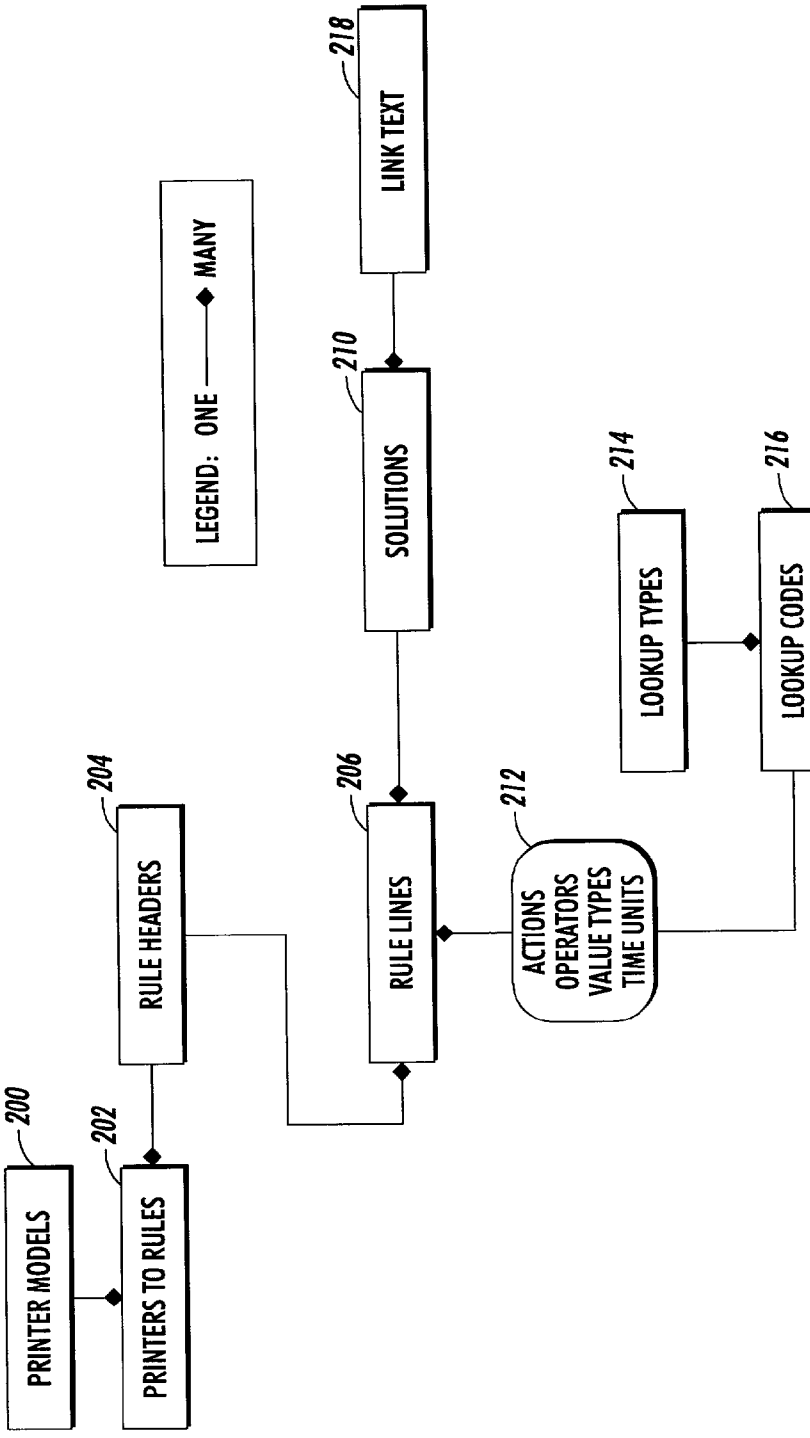

LEGEND: ONE ◆ MANY
PRINTER MODELS
200
PRINTERS TO RULES
202
RULE HEADERS
204
RULE LINES
206
SOLUTIONS
210
LINK TEXT
218
ACTIONS
OPERATORS
VALUE TYPES
TIME UNITS
212
LOOKUP TYPES
214
LOOKUP CODES
216

FIG. 6

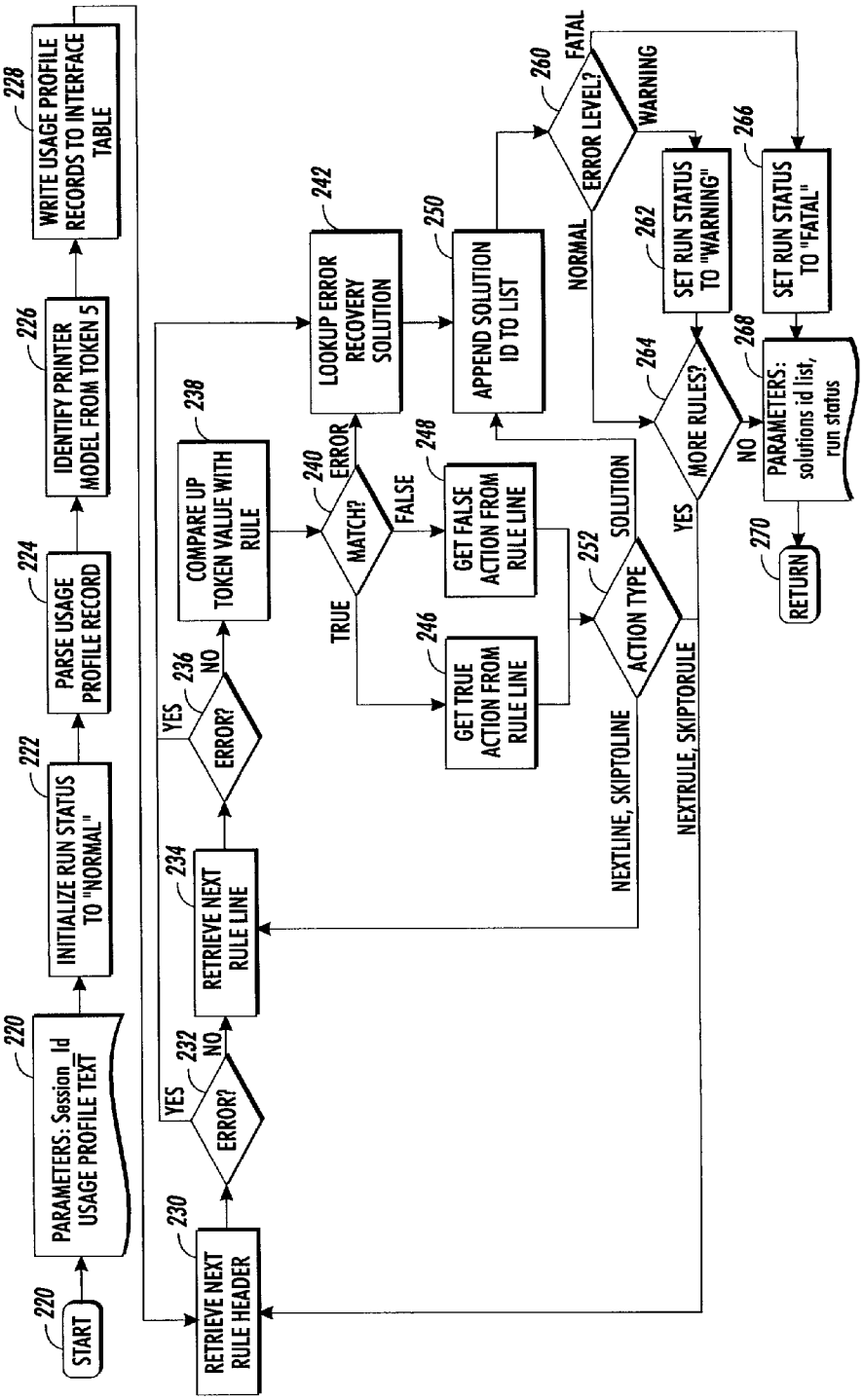

220
START
RETRIEVE NEXT RULE HEADER
230
PARAMETERS: Session_Id USAGE PROFILE TEXT
220
YES
232
NO
ERROR?
RETRIEVE NEXT RULE LINE
234
INITIALIZE RUN STATUS TO "NORMAL"
222
PARSE USAGE PROFILE RECORD
224
IDENTIFY PRINTER MODEL FROM TOKEN 5
226
WRITE USAGE PROFILE RECORDS TO INTERFACE TABLE
228
YES
236
NO
ERROR?
COMPARE UP TOKEN VALUE WITH RULE
238
LOOKUP ERROR RECOVERY SOLUTION
242
240
ERROR
MATCH?
TRUE
FALSE
GET TRUE ACTION FROM RULE LINE
246
GET FALSE ACTION FROM RULE LINE
248
APPEND SOLUTION ID TO LIST
250
NEXTLINE, SKIPTOLINE
SOLUTION
252
ACTION TYPE
NEXTRULE, SKIPTORULE
260
FATAL
ERROR LEVEL?
WARNING
NORMAL
SET RUN STATUS TO "WARNING"
262
SET RUN STATUS TO "FATAL"
266
264
MORE RULES?
YES
NO
268
PARAMETERS: solutions id list, run status
270
RETURN

FIG. 7

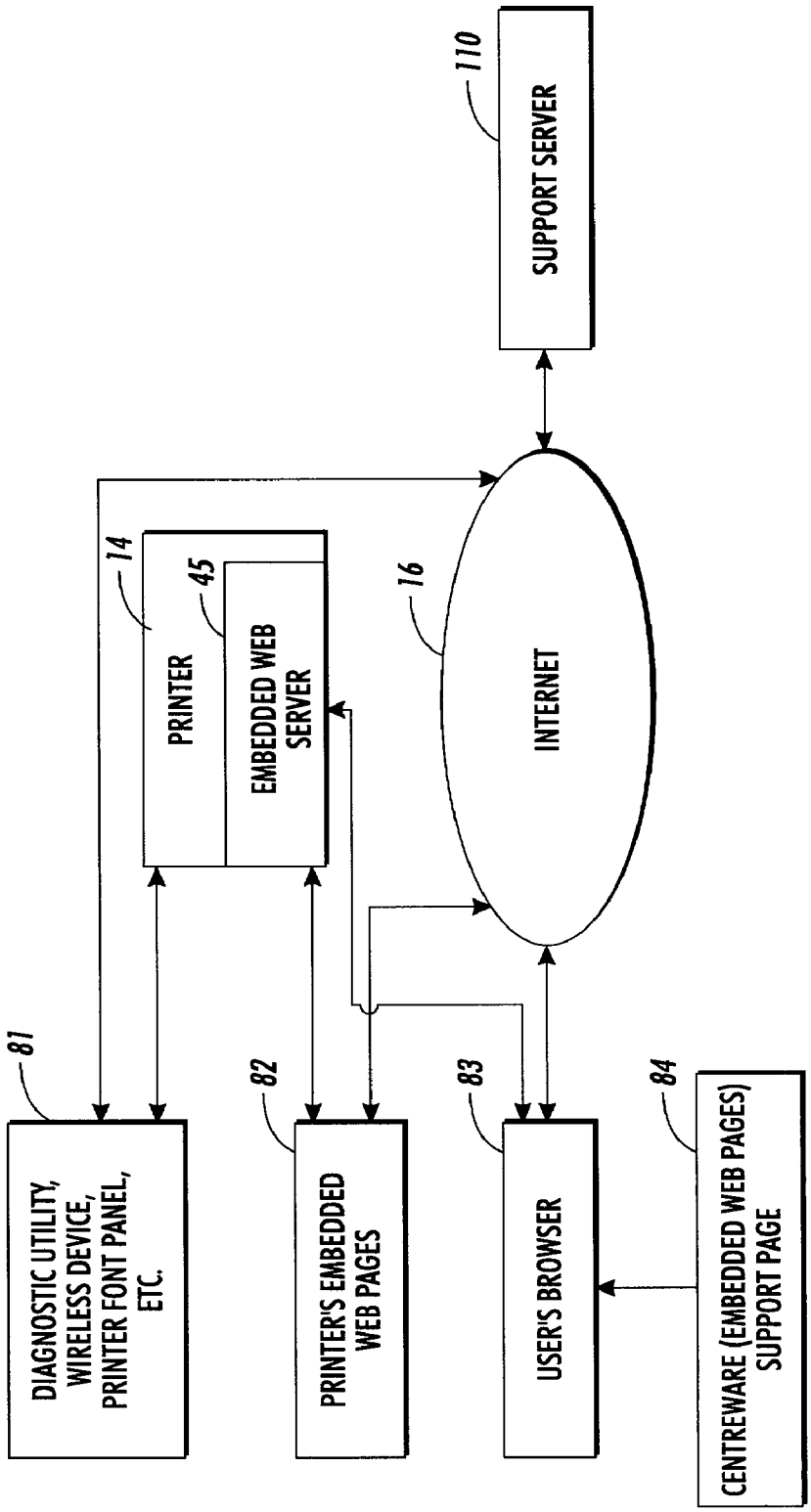

110
SUPPORT SERVER
14
PRINTER
45
EMBEDDED WEB SERVER
16
INTERNET
81
DIAGNOSTIC UTILITY, WIRELESS DEVICE, PRINTER FONT PANEL, ETC.
82
PRINTER'S EMBEDDED WEB PAGES
83
USER'S BROWSER
84
CENTREWARE (EMBEDDED WEB PAGES) SUPPORT PAGE

FIG. 8

SYSTEM AND METHOD FOR AUTOMATED PRINTER DIAGNOSTICS

FIELD OF THE INVENTION

[0001] This invention relates generally to a system and method for automated printer diagnostics, and more particularly to a system and method which relies primarily on printer generated diagnostic information.

BACKGROUND OF THE INVENTION

[0002] When a user has a problem with a printer, typically the user will first attempt to ascertain and fix the problem using whatever built-in diagnosis tools were provided with the printer, if any. For some printers the built-in diagnostic tools may be in the form of a user manual or diagrams on the user interface showing possible locations of printer jams and out-of-supply notices. For printers linked to a personal computer, the install disk of the printer may include diagnostics in the form of a utility program to be run on the user's personal computer. Utility programs may offer suggestions for relatively minor problems, such as cleaning inkjets to improve print quality or how to ascertain a printer jam. When the local diagnostic aids are insufficient to solve the user's printing problem, the user is faced with the decision of taking the printer to a service center (which usually only occurs if the printer is small enough for the user to transport) or requesting a service call from a service technician.

[0003] Diagnosing and fixing problems in larger, more complex printers in the field of necessity requires a telephone call to the service center or call center. Depending on the protocol at the particular service center, a product support representative will log in the user's printer complaint, issue a Request ID (RID) to identify the service request and then attempt to solve the problem over the phone. To attempt to solve the problem over the phone, the support representative will make suggestions to the user, which the user will perform on the printer and report back the result, if any. If the problem is resolved, the service call is closed. Otherwise, the service call goes through an escalation process. This may include transferring the call to a different service representative (who may be more skilled or skilled in different problem area) who asks different questions and makes different suggestions. If the escalated phone process is not successful, a field technician is dispatched. While all human-assisted calls, not including the cost of maintaining a service staff at a particular staffing level, are more expensive than automated response systems, dispatching a field technician to the printer is the most expensive.

[0004] With the advent of the Internet, many companies have established web sites to market their products, enable users to download upgrades to various software products and drivers and provide online service. Some computer manufacturers offer a special technical service software package which a user downloads to his/her computer, enabling the user to connect directly to the computer manufacturer service site for support. Compaq, for example, has a dial-up remote diagnostic system for personal computer customers. Hewlett Packard offers a service called "Instant Support", primarily intended for personal computers, which enables users to automatically check their system for components, search for answers that match a system configuration, connect to a support specialist, send a detailed report to a support specialist and ask questions. This type of support is reportedly being extended to the printer industry in that Hewlett Packard offers an automated Web-based diagnostic and resolution support service for embedded Web server-enabled (EWS) printers, which is intended to help users anticipate, address and resolve printer-specific problems. The intent of such systems is aimed at facilitating the use of phone support as an alternative to on-site service.

[0005] While improved use of phone support is helpful to users and reduces costs to manufacturers, there is a need for a remote diagnostic system and method which minimizes or does not require human intervention.

SUMMARY OF THE INVENTION

[0006] A support system for diagnosing printer problems, according to the invention, includes a support server a rules engine for parsing printer diagnostic data into components, for analyzing the components and for generating a suggested solution based on combinations of printer diagnostic data and error conditions; and at least one printer, located remote from the support server, and which includes a printer driver. When a user encounters a printer problem, the user selects the printer driver, which sends a request for support to the support server. The rules engine needs printer diagnostic data in order to suggest a solution. Printer diagnostic data may be obtained by one or a combination of methods. The support server may cause a printer diagnostics utility to be sent to the printer. The printer runs the printer diagnostics utility which generates a set of printer diagnostic data and transmits the data to the support server. An advantage of using downloaded printer diagnostics utilities is that the utility can be updated from time to time to retrieve or generate different types of data. If the printer includes a utility which generates and stores printer usage information and printer status information during operation of the printer, that information may be transmitted to the support server instead of the printer diagnostic data generated by the printer diagnostics utility or in addition to the printer diagnostic data. Indeed, printer diagnostic data may include any data stored in the printer memory.

[0007] The rules engine then parses the printer diagnostic data into components and analyzes the components in order to determine a cause for the printer problem. The rules engine then determines a suggested solution set for the problem and transmits the suggested solution to the printer. The suggested solution set is typically determined from a database of solutions based on printer diagnostic data and error conditions.

[0008] In one particular embodiment, the printer is coupled to a computer having a web browser for connecting to the Internet and the printer contains a usage utility and an embedded web server. The user requests support by accessing the printer driver (which will contain a link for support). The printer driver invokes the user's default browser with a URL argument. The URL is the IP address of the printer (e.g. http://13.62.154.233/xerox upr tech post) and the web server displays a web page in the web browser. The printer's web server calls postscript functions which extract diagnostic data (generated from the usage utility resident on the printer) and package them in an HTML form variable. Immediately

after the page loads in the user's browser, it automatically submits the HTML form via HTTP to the support server. The support server calls the rules engine, the rules engine parses and returns a record set of solution links. The support server constructs a web page and returns it to the user's browser.

[0009] The system may also store historical information such as a record of the service request, the printer diagnostic data, and the suggested solution at the support server. Warranty information may be stored in the support server and the warranty entitlement information may be checked at the time of the initial request. Any stored historical information may be provided to the user along with the suggested solution to the current problem. Thus the user sees a very simple, elegant interface with all the complex data interactions done behind the scenes. All of the information sent to the support server is collected without requiring the user to perform any diagnostic tests directly or to answer questions or to interact with the support server or a service technician.

[0010] In the event the suggested solution does not fix the printer problem, the user can access a phone support system. The phone support system can access all printer diagnostic data received at the support server during the automated process and use that data to facilitate telephone support or for a service representative call.

[0011] The system may be used on any network, whether intranet or extranet (e.g., the Internet), although it is expected that most users would contact the support server over the Internet. The printer driver may include a web browser for pointing to a web page at the support server.

[0012] The system and method of the invention offer many advantages. For example, the system enables use of printer generated status data to enable a diagnosis, as opposed to customer entered information alone. A centralized support server implementing a rules engine enables the support center to have the latest diagnostics utilities as well as the latest solutions to errors. Use of the Internet as a medium to allow data transfers to take place enables a large number of users to communicate quickly and efficiently with the support server. If the printer includes software for collecting usage profile information, including supplies usage information, and printer status information, such information can also be transmitted to the support server for use in analysis by the rules engine. The system and method of the invention automates the service call handling process and reduces the cost of support while also allowing a 24-hr/day by 7 days/week support coverage for the customer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] **FIG. 1** is a block diagram of a support system for diagnosing printer problems;

[0014] **FIG. 2** is a block diagram of a printer shown in **FIG. 1**;

[0015] **FIG. 3** is a block diagram illustrating the architecture for a service request in the support system;

[0016] **FIG. 4** is another block diagram of an architecture for a support system;

[0017] **FIG. 5** is another block diagram of an architecture for a service request and result in a support session;

[0018] **FIG. 6** is a block diagram of the entity relationships between the elements in the rule engine;

[0019] **FIG. 7** is a block diagram of the process flow in the rules engine; and

[0020] **FIG. 8** is a block diagram illustrating several ways of communication between the printer and the support server.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Referring to **FIG. 1, a** system for providing support **10** includes a support server **12** and one or more printers **14**, located remote from the support server **12**. Communication between support server **12** and printer **14** is made via the Internet **16**, or such other communications channel as may be available. The Internet is particularly useful because it provides a ubiquitous connection for large numbers of individuals and businesses.

[0022] A typical printer **14** is shown in **FIG. 2**. Printer **14** includes printer hardware **20** for receiving a print medium, transferring ink or toner in the form of an image onto the print medium and exiting the printed print medium. Printer controller **22** controls operation of the printer hardware. The functions contained with box **28** may be located within the printer **14** (in the case of larger or production type printers), or they may be located on an external computer, such as a personal computer or a network server to which the printer is connected (in the case of smaller or simpler printers). Functions **28** include a user interface **24** for receiving a print job **30**, processor **26** and memory **40**. Processor **26** executes the printer driver **42** stored in memory **40**. After the print job **30** is interpreted by processor **26** and stored as yellow, cyan, magenta and/or black image data in memory **40**, printer controller **22** causes the printer **20** to feed a print medium from a media tray (not shown) and be processed through the printer **20** such that a full color and/or black and white image is transferred onto the print medium, which is then fed by means of an exit path from the printer.

[0023] To communicate with support server **12** via the Internet, printer driver **42** may include a web browser **44**. Alternatively, the printer driver **42** may communicate through a web browser located on the computer or network to which the printer **14** is connected. Printer **14** may optionally include a usage utility **46**. The usage utility **46** gathers various usage information and printer status information during operation of the printer **14** and stores a record of it, usually called a usage profile or usage profile information, in the memory **40**. As described later, when a request for service is made to the supply server **12**, the support server will request any usage profile information stored about the printer be sent to it for analysis. Alternatively, the printer may send the usage profile information with the request for support.

[0024] To aid in the diagnosis of a printer problem or if the printer does not contain a usage profile utility for generating usage profile information, the support server **12** may send a printer diagnostic utility **13** to the printer **14**. On receipt the printer **14** runs the diagnostic utility **13** and generates a set of printer diagnostic data which is sent to the support server **12** for analysis. Of course, a printer with a usage utility and stored usage profile information may also download and run the printer diagnostic utility. All data received from the printer **14** by the support server **12** will be parsed and analyzed by the rules engine **15** and a suggested solution

generated and transmitted back to the printer **14**. Any other data stored in the printer memory **40** may also be sent to the support server for analysis by the rules engine.

[**0025**] A more detailed example of a printer diagnostic system and method will be described with respect to a system and method to be used with Xerox solid ink printers called PhaserSMART. PhaserSMART is a web-based application that analyses information from a user's printer and returns web-based, self-support solutions to the user. In addition to providing printer information analysis, PhaserSMART can be used to combine other systems such as infoSMART (an interactive online support module) and OpenUPTIME (a worldwide customer management system which maintains inventory and manufacturing data). PhaserSMART, for purposes of this example, is used with printers that have a Usage Profile utility resident in the printer firmware. The Usage Profile utility gathers usage information and printer status information during operation of the printer and stores it in a local memory.

[**0026**] A block diagram of the architecture of the PhaserSMART system is shown in **FIGS. 3, 4, 5** and **8**. Several methods of accessing the printer **14** in order to request support from support server **110** are shown in **FIG. 8**. First, the printer **14** may be connected to a personal computer, wireless telephone, personal digital assistant or any device that can accept an IP address. Typically, this means that the device **81** (including the printer itself through a front panel input device) includes a memory and processor running a web browser or application for communicating over the Internet.

[**0027**] In this embodiment, the user accesses printer **14** through a personal computer with a web browser. PhaserSMART presents all information to the user via a web browser **83**, which may be any available web browser such as Netscape 4.x and IE 4.x or greater browsers or other such browsers that are JavaScript 1.1 compatible, and support standard frames, tables, and other common HTML elements. The web browser **83** used should have cookies enabled and the web-based user interface may be 640 pixels wide by 480 pixels high, excluding the browser window. The web browser **83** provides exclusive navigation for the user in this embodiment. The user would open the printer driver application on his personal computer **50** and select technical support link on the troubleshooting tab. This action causes a dialog box **52** to be displayed for the user. A form call **54** is made to the printer **14**, which directs that any stored usage profile information **56** be sent to the support server **110**. Usage profile information **56** (in the form of a single field, Updata) is appended to a support request **108** in the form of an HTTP post which is sent via the Internet to support server **110**. Updata contains Usage Profile information generated by the usage profile utility resident on the printer.

[**0028**] Alternatively, in the case where the printer **14** includes an embedded web server **45**, when the user opens the printer driver application on his personal computer **50** and selects technical support link on the troubleshooting tab, this action causes the user's web browser **45** to display, invoking a form call **54** to the printer's embedded web server **45**, which returns a web page **82** with an HTML form to be sent to the support server **110**. Usage profile information **56** (in the form of a single field, Updata) comprises the support request **108** in the form of an HTTP post which is sent via the Internet to support server **110**. This form is automatically submitted when the user's browser loads the web page **82** returned by the printer's embedded web server. Updata contains Usage Profile information generated by the usage profile utility resident on the printer. An alternative web page generated by the printer's embedded web server is the CenterWare Support page **84** which is displayed in the user's browser **83**.

[**0029**] Table 1 shows a sample usage profile record that might be collected for a particular user's printer.

Sample Usage Profile Record

1=Date of Report=Thu Nov 16 17:43:47 2000;
2=Activation Date=Mon Oct 23 23:25:59 2000;
3=Printer IDs=Serial #:BCLP356, Ethernet:08:00:11:0F:01:33, IP:13.62.70.236, —:xxxxxx;
4=Printer Name=Steffen's_BC;
5=Printer Type=Model:Phaser 860DP, Printer Class:Solid Ink;
6=Adobe Firmware=3010.108 (11);
7=Xerox Firmware=VxWorks:3.18, Engine:14.20, PostScript:14.18, Network:12.48.10.18.2000;
8=Installed RAM (MBs)=128;
9=Installed Trays (incl. Manual)=3;
10=Accessories=Duplexer, , ,;
11=Current Media=Upper Tray:Transparency-Letter, Middle Tray:—, Lower Tray:Paper-Letter, Manual Feed:Other-Other;
101=Report Intervals=Pages:1000, Hours:168;
111=Total Pages & Sheets=Pages:980, Sheets:924;
112=Total Pixels Printed (1K)=Cyan:889005, Magenta:1089088, Yellow:475571, Black:1029656;
113=Average Coverage (%)=Cyan:6, Magenta:7, Yellow:3, Black:8;
114=Coverage-Last 1000 Pages (%)=Cyan:6, Magenta:7, Yellow:3, Black:8;
115=Ink Consumed (Sticks)=Cyan:0.90481, Magenta:1.08198, Yellow:0.50879, Black:1.15476;
116=Pixels Printed Cyan (1K)=Fast Color:10453, Standard:588447, Enhanced:2436, High-Resolution/Photo:287669;
117=Pixels Printed Magenta (1K)=Fast Color:13880, Standard:651569, Enhanced:3615, High-Resolution/Photo:420024;

-continued

Sample Usage Profile Record

118=Pixels Printed Yellow (1K)=Fast Color:10831, Standard:371417, Enhanced:2694, High-Resolution/Photo:90629;
119=Pixels Printed Black (1K)=Fast Color:22223, Standard:944578, Enhanced:2454, High-Resolution/Photo:60401;
121=Paper vs. Transparency (pages)=Paper:939, Transparency:41, Other:0;
122=Pixels Printed-Paper (1K)=Cyan:798613, Magenta:974505, Yellow:425226, Black:708775;
123=Coverage-Paper (%)=Cyan:5, Magenta:6, Yellow:3, Black:5;
124=Pixels Printed-Transparency (1K)=Cyan:90392, Magenta:114583, Yellow:50345, Black:320881;
125=Coverage-Transparency (%)=Cyan:16, Magenta:20, Yellow:9, Black:56;
131=Color vs. Black & White (pages)=Color:821, Black & White:156, Blank:3;
132=Pixels Printed-Black & White (1K)=Cyan:0, Magenta:0, Yellow:0, Black:85608;
133=Coverage-Black & White (%)=Cyan:0, Magenta:0, Yellow:0, Black:4;
134=Pixels Printed-Color (1K)=Cyan:889005, Magenta:1089088, Yellow:475571, Black:944048;
135=Coverage-Color (%)=Cyan:7, Magenta:8, Yellow:4, Black:8;
141=1-Sided vs. 2-Sided (sheets)=1-Sided:868, 2-Sided:56;
143=Manual Feed Media (sheets)=Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
144=Cassette Tray Media (sheets)=Upper-Paper-Letter:0, Upper-Paper-Legal:0, Upper-Paper-A4:0, Upper-Transparency-Letter:41, Upper-Transparency-A4:0, Middle-Paper-Letter:0, Middle-Paper-A4:0, Lower-Paper-Letter:883, Lower-Paper-A4:0;
151=Print Quality (pages)=Fast Color:46, Standard:903, Enhanced:3, High-Resolution/Photo:28;
152=Color Correction (pages)=None:1, Vivid Color:0, Simulate Display:2, SWOP Press:0, Euroscale Press:0, Commercial Press:0, Black and White:0, Raw CMYK:20, Raw RGB:0, Automatic:957, Toyo Press:0, Dai Nippon Press:0, Fuji Press:0, Newsprint:0, Non-PostScript:0, Undefined:0;
161=Sets Printed (pages)=First Set Pages:951, Subsequent Set Pages:19;
162=Jobs By Document Length=0–1:132, 2–4:77, 5–9:14, 10–19:8, 20–29:2, 30–49:4, 50–74:2, 75–99:1, 100–249:0, 250+:0;
163=Jobs By Number of Sets=0–1:233, 2–4:7, 5–9:0, 10–19:0, 20–29:0, 30–49:0, 50–74:0, 75–99:0, 100–249:0, 250+:0;
164=Pages By Document Length=0–1:141, 2–4:233, 5–9:77, 10–19:112, 20–29:48, 30–49:159, 50–74:120, 75–99:80, 100–249:0, 250+:0;
165=Pages By Number of Sets=0–1:940, 2–4:30, 5–9:0, 10–19:0, 20–29:0, 30–49:0, 50–74:0, 75–99:0, 100–249:0, 250+:0;
171=Job Source=Internal:5, EtherTalk:0, Parallel:14, USB:0, FrontPanelJobInput:7, AppSocket:220, FTP:0, LPR:0, Remote Internet Printing:0, TokenTalk:0, PrintServer:0, IPP:3, Other:0;
172=Job Language=PostScript:241, PCL:0, AutoSelect:0, Scanner:0, PDF:0, Other:0;
173=Jobs Collated=No:241, Yes:0;
174=Time Per Job (mins)=0–1:217, 2–3:13, 4–9:10, 10–29:0, 30–59:0, 60+:0;
175=Total Jobs=Printing Jobs:241, Non-Printing Jobs:8;
176=Cancelled Jobs=3;
181=Days Printed=24;
182=Pages Per Day=0–1:7, 2–4:1, 5–9:1, 10–24:2, 25–49:7, 50–99:3, 100–249:3, 250–499:0, 500–999:0, 1000+:0;
183=Power On Count=6;
184=Time On Distribution (hours)=0–1:1, 2–3:0, 4–9:0, 10–23:3, 24–167:0, 168+:1;
185=Days Since Activation=23;
186=Hours Since Last Power On=345;
187=Total Time On (hours)=569;
188=Power Off Page#=0, 0, 3141, 3142, 3366;
189=Power Off Date Log=—, —, Wed Oct 25 15:05:34 2000, Wed Oct 25 15:08:26 2000, Wed Nov 01 17:55:55 2000;
191=Total Warmup Time (hours)=1;
192=Total Offline Time (hours)=0;
193=Total EnergyStar Time (hours)=0;
194=EnergyStar Time Distribution (mins)=0–14:0, 15–29:0, 30–119:0, 120–299:0, 300–599:0, 600+:0;
201=JetStack StandBy Time (hours)=28;
202=JetStack StandBy Time Distribution (mins)=0–14:5, 15–29:0, 30–119:30, 120–299:0, 300–599:0, 600+:0;
203=StandBy Time (hours)=373;
204=StandBy Time Distribution (mins)=0–14:3, 15–29:1, 30–119:3, 120–299:0, 300–599:1, 600+:17;
221=Maintenance Kit Installation Date=Wed Aug 09 07:39:13 2000;
222=Maintenance Kit Remaining (%)=59;
223=MKIC=4354;
224=Maintenance Kit Consumption Rate=Low:0, Medium:0, High:980;
231=Doors Open=Front Cover:6, Exit Cover:0, Top Cover:2;

-continued

Sample Usage Profile Record

232=Supplies Replaced=Ink-Low:0, Ink-Empty:0, Maintenance Kit-Low:0, Maintenance Kit-Empty:0, Other:0;
233=Paper Out=Upper Tray:2, Middle Tray:0, Lower Tray:10;
234=Button Presses=328;
235=Feature=Info Button:4, Supplies Info Menu:1, Network Setup Menu:0, Printer Setup Menu:0, Job Defaults Menu:0, Printable Pages Menu:10, Service Pages Menu:0, Support Menu:3, Printer Identification:6, Improve Print Quality?:1, Network Questions?:0, Resolve Paper Jams:0, Service Tools Menu:0, TroubleShoot Jams:0;
237=Printer Status=0, 10, 0, 6, 9, 6, 10, 0, 10, 0, 10, 0, 10, 0, 18;
251=System Reset Count=0;
252=System Reset Log=0, 0, 0, 0, 0;
253=System Reset Page#=0, 0, 0, 0, 0;
254=System Reset Date Log=—, —, —, —, —;
261=Engine Error Count=0;
262=Engine Error Log=—, —, —, —, —, —, —, —, —, —, —, —, —, —, —, —, —;
263=Engine Error Page#=0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0;
264=Engine Error Date Log=—, —, —, —, —, —, —, —, —, —, —, —, —, —, —, —, —;
265=Jam Error Count=10;
266=Jam Error Log=—, —, —, —, —, —, —, —, —, —, 22,705.07, 22,024.01, 22,024.01, 22,024.01, 22,500.00;
267=Jam Error Page#=0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2164, 2199, 2614, 2826, 3001;
268=Jam Error Date Log=—, —, —, —, —, —, —, —, —, —, Thu Oct 12 11:45:36 2000, Thu Oct 12 13:42:32 2000, Wed Oct 18 12:04:43 2000, Fri Oct 20 09:31:24 2000, Tue Oct 24 18:34:47 2000;
271=PostScript Error Count=0;
272=PostScript Error Log=0, 0, 0, 0, 0;
273=PostScript Error Page#=0, 0, 0, 0, 0;
274=PostScript Error Date Log=—, —, —, —, —;
280=Print Head Auto Clean Source=PowerUp:0, EnergyStar:0;
281=PrintHead Clean Count=Automatic:0, Manual:0;
282=PrintHead Clean Source=—, —, —, —, —, —, —, —, —, —;
283=PrintHead Clean Page#=0, 0, 0, 0, 0, 0, 0, 0, 0, 0;
284=PrintHead Clean Date Log=—, —, —, —, —, —, —, —, —, —;
285=PrintHead Installation Page#=0, 0, 0, 0, 0, 0, 0, 0, 0, 2938;
286=PrintHead Installation Date Log=—, —, —, —, —, —, —, —, —, Mon Oct 23 23:25:59 2000;
287=PrintHead Purge Count=Cold Purge:0, Warm Purge:0, High Voltage Cold Purge:0, High Voltage Warm Purge:0;
291=Last Jam Location=—, —, —, —, Jam D;
292=Last Jam Media Tray=—, —, —, —, Upper Tray;
293=Last Jam Media=—, —, —, —, Upper-Paper-Letter:;
294=Last Jam Page#=0, 0, 0, 0, 3001;
295=Last Jam Date Log=—, —, —, —, Tue Oct 24 18:35:06 2000;
296=Last Jam Transfix Speed=—, —, —, —, 5IPS;
301=Jam A (Upper Tray)=Upper-Paper-Letter:0, Upper-Paper-Legal:0, Upper-Paper-A4:0, Upper-Transparency-Letter:0, Upper-Transparency-A4:0;
302=Jam B (Middle/Lower Trays)=Middle-Paper-Letter:0, Middle-Paper-A4:0, Lower-Paper-Letter:0, Lower-Paper-A4:0;
303=Jam C (Exit Cover)=Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
304=Jam D (Front Cover)=Paper-Letter:1, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
305=Jam E (Exit Tray)=Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
307=Jam Manual Feed=Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
331=JetStack PF Count=7;
332=JetStack PF Hours=267.97;
333=JetStack PF Log=0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 35.77, 78.21, 14.59, 17.16, 19.02, 83.11, 20.09;
334=JetStack PF Date Log=—, —, —, —, —, —, —, —, —, Fri Oct 27 15:09:57 2000, Tue Oct 31 09:02:49 2000, Mon Nov 06 09:02:29 2000, Wed Nov 08 09:03:55 2000, Fri Nov 10 09:04:32 2000, Tue Nov 14 09:25:16 2000, Thu Nov 16 09:25:54 2000;
335=JetStack PF Page#=0, 0, 0, 0, 0, 0, 0, 0, 3198, 3243, 3463, 3490, 3591, 3671, 3880;
401=Diagnostic Result #0=ID:23,TS:6,PC:3806,Thu Nov 02 2000,08:21:28,R0:180.0000,R1:180.0000,R2:180.0000,R3:0.0000,R4:180.000;
402=Diagnostic Result #1=ID:23,TS:6,PC:2663,Thu Oct 12 2000,16:32:57,R0:180.0000,R1:180.0000,R2:180.0000,R3:0.0000,R4:180.000;
403=Diagnostic Result #2=ID:23,TS:6,PC:2635,Thu Oct 12 2000,13:42:02,R0:180.0000,R1:180.0000,R2:180.0000,R3:0.0000,R4:180.000;
404=Diagnostic Result #3=ID:23,TS:6,PC:2635,Thu Oct 12 2000,13:39:10,R0:180.0000,R1:180.0000,R2:180.0000,R3:0.0000,R4:180.000;
405=Diagnostic Result #4=—;
406=Diagnostic Result #5=—;

-continued

Sample Usage Profile Record

411=WarmUp Mode =Intelligent Ready;
412=Adaptive Data Sun =—, —;
413=Adaptive Data Mon =—, —, —, —, —, —, —, —, —, 2, 2, 2, 2, 2, —, —, 3, 3, 3, 2, 3, ,3, —, —, —, —;
414=Adaptive Data Tue =—, —, —, —, —, —, —, —, —, —, 2, 2, 3, 2, —, 3, 3, —, —, 1, —, —, —, —, —;
415=Adaptive Data Wed =—, —, —, —, —, —, —, —, —, —, 2, 1, 3, —, 3, —, 3, —, 3, 2, —, —, —, —, —;
416=Adaptive Data Thu =—, —, —, —, —, —, —, —, 2, 3, 3, 3, 2, 2, 3, —, —, 3, —, —, —, —, —, —;
417=Adaptive Data Fri =—, —, —, —, —, —, —, —, —, 3, —, 2, 2, 1, 3, 3, 3, 2, 2, —, —, —, —, —;
418=Adaptive Data Sat =—, —;
419=Warmup Setting =Sun :-1, Mon :-1, Tue :-1, Wed :-1, Thu :-1, Fri :-1, Sat :-1;
420=Standby Setting =Sun :-1, Mon :-1, Tue :-1, Wed :-1, Thu :-1, Fri :-1, Sat :-1;
END Usage Profile Report (For User)
1001=Profile Error Count=3;
1002=Profile Error Log=0, 0, 127, 101, 117;
1003=Profile Error Page#=0, 0, 3001, 3001, 3415;
1011=Page Count Trigger=500;
1012=Time Trigger (hours)=84;
1013=Jam Count Trigger=5;
1021=Polling Interval=2;
1022=Email on First Jam=0;
1023=Restart Count Trigger=5;
1031=Pages From Engine=Usage Profile:970, Total Pages:3908;
1033=Verification State=0xc0;
1034=Recent Coverage Page Setting=1000;
1035=Supplies Replaceable Interval=2, 60;
1036=Total Percent Coverage (pages)=0–9:512, 10–24:303, 25–49:44, 50–99:27, 100–199:94, 200+:0;
END Usage Profile Report

[0030] The first action upon receipt of the support request **108** at the support server **110** is to validate that the Usage Profile information has been received. Support server **110** has an Oracle based Rules Engine **111** which parses the Usage Profile information into a readily accessible format and stores the information in the Usage Profile database **116** and starts a user session in the Customer Session database **118**. The fields of interest from the Usage Profile information for the Session database **118** include serial number of printer **14**, model number, Usage Profile timestamp and printer IP address. The user's usage profile data are submitted to the Oracle stored procedure created for the Rules Engine. The Rules Engine parses the Usage Profile data, performs an analysis, and returns an error status, an error message (possibly null), and a record set of solutions. The error status describes the relative success of the analysis and may be one of normal, warning or fatal.

[0031] On a normal or warning condition, the Rules Engine will return a record set. The record set contains:

Column Name	Description
Status_code	One of three values, see table below
error_level	The error level returned by the Rules Engine
link_text_id	The Link text for the URL
solution_content	The solution URL
description	The solution description
name	The name of this solution

[0032] Each row in this record set represents one of three conditions. The solution_id table documents those conditions:

Status Message	Action
RuleFailure	An error occurred within the Rules Engine while processing rules. - Contact Rules admin
Positive	A "dead-ringer" solution was discovered for the user's problem. The user can fix the problem with parts. - Display these first
Indeterminate	The solution was uncertain. - Display these next

[0033] If the problem is Positive, and a solution **68** is available within the infoSMART database **124**, the solution is sent to the user. If the problem is Positive and the user "needs service", the URL points to a separate template path **66** within the application. The user is prompted for contact information and the service request is assigned for processing by the field service teams if the printer is under warranty or contract. If the service job is billable, the user is directed to contact customer support. In all cases, the exit page updates the session record to capture the end timestamp, the exit route, if the problem was solved, the solution type and the infoSMART ID and key, if any.

[0034] The Rules Engine provides mechanisms to tie the information received from a user to the appropriate self-support solution. A function of the Rules Engine is to interface with the support server to deliver a solution to the user via the user's browser. The rules that the Rules Engine relies on are stored in the Rules Engine database **122**. These rules are stored in a database for easy addition, modification, and maintenance. As new printers are developed to use PhaserSMART, Rules Administrators must be able to define and add rule sets rapidly and easily.

[0035] The Rules Engine contains a set of Rules stored in Rules Engine database **122** for each printer type. These

Rules consist of analysis of combinations of Usage Profile tokens that represent error conditions, or symptoms within a printer. The Rules Engine database **122** associates Rule lines with solution Ids, which reference solutions stored within the infoSMART database **124**. The Rules Engine **122** returns a solution list and a status message **68**, which is transmitted by the support server **110** to the printer via the web browser. The web application may transmit the solution list and status message in the form of a URL (uniform resource locator), which the user can access via the web browser. The URL directs the user to an infoSMART solution in the infoSMART data base **124**. No solutions returned by the Rules Engine require display of an interactive diagnostic session.

[**0036**] Referring to **FIG. 4**, an optional web based Customer Support interface **112** permits call center agents to view user session information and submission history **62**. An optional reports module **114** generates reports **64** of service active for administrative and other purposes. Some of these reports may include a record of each discrete activity or event and the calculated proficiency of events (the percentage of events that result in a fix relative to total events). The reports can be used to measure the Rules Engine's sessions solved and sessions which result in a call to the Support Center.

[**0037**] The PhaserSMART system of this embodiment generates four use scenarios. In the first scenario, the user obtains an instant self-support solution. In this case, the information submitted to the Rules Engine contains a "dead ringer." This information is identified by the system and a solution to the identified problem is immediately displayed. The system runs its pattern matching algorithm against the Usage Profile information and system rules. The system finds a high probability solution match. The system finds an associated solution ID in the solution lookup table. The system displays the infoSMART solution **68** on the Rules Engine Resolution page. The user attempts the fix provided by the solution and it is successful. The user clicks an appropriate link on the dialog box **52** to indicate that the problem has been resolved. The system writes the session record including, infoSMART solution ID, resolution status, timestamp.

[**0038**] In the second scenario, the user obtains an interactive self-support solution. In this case, the information submitted to the Rules Engine does not contain a "dead ringer." Further information is needed from the user to diagnose the issue. The system runs its pattern matching algorithm against the Usage Profile information and system rules. The system does not find a match. The system displays a User Choice page with links to interactive diagnostics and other support links. The user chooses the interactive diagnostic link. The system does an analysis of the Usage Profile information to assess where in the infoSMART decision trees to place the user. The system loads the infoSMART decision tree in the main display frame. The user navigates the decision tree, answering questions that narrow the issue to a solution or set of solutions. The system displays the infoSMART solution on a Resolution page. The user attempts the fix provided by the solution. The user clicks the button to indicate that the problem has been resolved. The system writes the session record including, infoSMART solution ID, resolution status, timestamp.

[**0039**] In the third scenario, the end user needs service (a service call from a service representative. In this case, the information submitted to the Rules Engine or the decision tree path leads to a solution that calls for servicing the printer. The system runs its pattern matching algorithm against the Usage Profile information and system rules. The system finds a high probability solution match. The system finds a service needed entry in the solution lookup table. The system displays a page notifying end user of need for service with a "send technician" option. The user clicks yes or no on sending a technician. The system opens a request for a service technician. The system checks for warranty or contract. If not billable, system displays exit page with request ID and assigns the job. If billable, the system displays a Call Choice page. The user chooses to contact a service center or have a service center contact them.

[**0040**] In the fourth scenario, the Customer Support Agent views a user's Rules Engine session. In this case, the user was not able to resolve their issue via the Rules Engine. As a result, they were assigned a Request ID and have called support. The Customer Support Agent needs to access the user's information. The Customer Support Agent takes a call from an PhaserSMART escalation customer. The Customer Support Agent gets the Request ID (RID) from the customer and opens the support session. The Customer Support Agent launches a web browser from a URL, within the OpenUPTIME system, with RID included. The system queries the PhaserSMART database for the most recent user session. The Customer Support Agent uses the session history and standard troubleshooting techniques to verify problem. The problem is fixed, escalated, or dispatched to field service following standard OPB Customer Support practices. Additional, contingent Use Cases are also possible to implement with the PhaserSMART system.

[**0041**] On completion, the first three scenarios automatically open a service request through a PL/SQL package interface to special interface tables (the OpenUPTIME T_Tables). This integration automates much of the manual information collection into an existing customer support system and automates the routing of requests. This also enables updating of databases. The invention may be used alone or in combination with the methods described in co-pending, co-assigned patent application D/A1151, Printer Diagnostics Method, David I. Bernklau Halvor, filed the same date as this application, which is incorporated herein by reference. D/A1151 describes a method of diagnosing a printer, where the printer is one of a particular type, includes performing a series of parametric tests on the printer at the time of manufacture to generate a set of baseline values for the printer and storing the baseline results. The baseline results may be stored remotely or with the printer, or both. A set of maximum parametric test variations for the printer type is generated, such that each maximum parametric test variation is associated with a particular printer fault event. At the time of a suspected printer fault, the same parametric tests are performed and a set of suspected fault values generated. The difference between the suspected fault value and the baseline value is calculated for each parametric test. If the difference for a particular parametric test is greater than the maximum parametric test variation for that particular parametric test, the particular print fault event associated with the parametric test value may be indicated. This information could be stored within a separate manufacturing database for access by the Rules Engine in diagnosing printer problems.

[0042] Usage Profile database **116** is used to store the Usage Profile information submitted from the user's printer. In addition to PhaserSMART submitted Usage Profile information, this database may also contain the Usage Profile information submitted via email from printers. The Rules Engine **111** first parses the incoming Usage Profile information and then formats it for insertion into the Usage Profile database **116**. The Customer Session Database **118** contains the records of the users' interactions with the PhaserSMART system. To provide tracking information, the session database **118** contains a log of any support requests opened and infoSMART session IDs. In addition to tracking information, the database captures any other user input requested by the support server **110**. The Rules Engine database **122** provides the location for rules and solution lookup tables. The rules tables relate printers to specific rule sets to match against incoming Usage Profile information. If a match is found, the solution table is queried to determine which infoSMART solution (stored in infoSMART Database **124**) should be displayed to the user. The Support Agent interface **112** defines the web screens that the Call Center agents use to interact with Rules Engine and the data sources it touches. The Support Agent screen includes of a list of recent interactions with the support server. Each interaction is represented by a link that shows the session detail when clicked. The screen permits several different ways to sort and filter the list of links that is displayed to the Support Agent. At the top of this screen, a portion may be reserved to display customer information such as model number, serial number, RID, product place notes, and customer notes.

[0043] The Report interface **114** allows internal users to measure overall traffic, solution delivery success, and product trending. It matches the serial numbers in against the PhaserSMART session database to determine how many of the PhaserSMART sessions were successful. Predefined or ad hoc reports may be generated.

[0044] The Rules Engine **111** parse all incoming user information, such as usage profile information, or data generated as a result of a downloaded printer diagnostics utility. An example of a Rules Engine used in the PhaserSMART system is described below and with reference to **FIGS. 6 and 7**.

[0045] Table 2 is a table of definitions used in the exemplary rule engine.

Table Definitions

ss_up_interface				create table ss_up_interface (
session_id	NUMBER(15)	NOT NULL	Primary key	session_id NUMBER(15) NOT NULL,
token_num	VARCHAR2(10)	NOT NULL		token_num VARCHAR2(10) NOT NULL,
token_desc	VARCHAR2(100)	NOT NULL		token_desc VARCHAR2(100) NOT NULL,
token_payload	VARCHAR2(2000)			token_payload VARCHAR2(2000),
status	VARCHAR2(20)	NOT NULL	Indicates status of records posted to UP database	status VARCHAR2(20) NOT NULL,
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
ss_lookup_types				kup_types(
lookup_type	VARCHAR2(25)	NOT NULL	primary key	lookup_type VARCHAR2(25) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
ss_lookup_codes				create table ss_lookup_codes (
lookup_type	VARCHAR2(25)	NOT NULL	foreign key	lookup_type VARCHAR2(25) NOT NULL,
lookup_code	VARCHAR2(25)	NOT NULL	primary key; reflected in program code for logic breaks	lookup_code VARCHAR2(25) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
active_flag	VARCHAR2(1)	NOT NULL	Can be 'Y' or 'N'	active_flag VARCHAR2(1) NOT NULL,
start_date	date			
end_date	date			

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Table Definitions

created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
solutions				create table solutions (
solution_id	NUMBER(15)	NOT NULL		solution_id NUMBER(15) NOT NULL,
name	VARCHAR2(100)	NOT NULL		name VARCHAR2(100) NOT NULL,
status_code	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'SolutionStatus'	status_code VARCHAR2(25) NOT NULL,
error_level	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'ErrorLevel'	error_level VARCHAR2(25) NOT NULL,
link_text_id	NUMBER(15)		Foreign key	link_text_id NUMBER(15),
solution_content	VARCHAR2(240)	NOT NULL		solution_content VARCHAR2(240) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
rule_headers				create table rule_headers (
rule_header_id	NUMBER(15)	NOT NULL	Primary Key	rule_header_id NUMBER(15) NOT NULL,
name	VARCHAR2(100)	NOT NULL		name VARCHAR2(100) NOT NULL,
symptom	VARCHAR2(240)			symptom VARCHAR2(240),
description	VARCHAR2(240)			description VARCHAR2(240),
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
rule_lines				create table rule_lines (
rule_header_id	NUMBER(15)	NOT NULL	Foreign key: rule_headers.rule_ header_id	rule_header_id NUMBER(15) NOT NULL,
rule_line_id	NUMBER(15)	NOT NULL	Primary key	rule_line_id NUMBER(15) NOT NULL,
rule_line_num	POSITIVE	NOT NULL	unique rule_line_id, rule_line_num	rule_line_num POSITIVE NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
primary_value_ type	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. LOOkup_code, lookup_type= 'RuleValueType'	primary_value_type VARCHAR2(25) NOT NULL,
primary_token_ num	VARCHAR2(10)			primary_token_num VARCHAR2(10),
primary_token_ name	VARCHAR2(100)			primary_token_name VARCHAR2(100),

-continued

Table Definitions

primary_parm_num	BINARY_INTEGER		for values >= 1: count from first; for values <= −1: count from last; 0 or blank: first parm	primary_parm_num BINARY_INTEGER,
primary_payload_key	VARCHAR2(100)		identify particular name:value pairs in payloads	primary_payload_key VARCHAR2(100),
parms_to_search	POSITIVE		for values >= 1: search through specified number of parameters ; 0 or blank = 1	parms_to_search POSITIVE,
operator	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'RuleOperator'	operator VARCHAR2(25) NOT NULL,
comparison_value	VARCHAR2(240)			comparison_value VARCHAR2(240),
secondary_value_type	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'RuleValueType'	secondary_value_type VARCHAR2(25) NOT NULL,
secondary_token_num	VARCHAR2(10)			secondary_token_num VARCHAR2(10),
secondary_token_name	VARCHAR2(100)			secondary_token_name VARCHAR2(100),
secondary_parm_num	BINARY_INTEGER		for values >= 1: count from first; for values <= −1: count from last; 0 or blank: first parm	secondary_parm_num BINARY_INTEGER,
secondary_payload_key	VARCHAR2(100)		identify particular name: value pairs in payloads	secondary_payload_key VARCHAR2(100),
comparison_units	VARCHAR2(25)		Foreign key: ss_lookup_codes. lookup_code, lookup_type='Units'	comparison_units VARCHAR2(25),
comparison_count	POSITIVE		Must be >= 1, or NULL	comparison_count POSITIVE,
action_true	VARCHAR2(25)	NOT NULL	Foreign key: ss_Lookup_codes. lookup_code, lookup_type= 'RuleAction'	action_true VARCHAR2(25) NOT NULL,
target_true	VARCHAR2(20)		A solution_id, other rule_id rule #, etc., or blank	target_true VARCHAR2(20),
description_true	VARCHAR2(240)			description_true VARCHAR2(240),
action_false	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'RuleAction'	action_false VARCHAR2(25) NOT NULL,
target_false	VARCHAR2(20)		A solution_id, other rule_id, rule #, etc., or blank	target_false VARCHAR2(20),
description_false	VARCHAR2(240)			description_false VARCHAR2(240),
created_by	NUMBER(15)	NOT NULL		created_by NUMBER(15) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	NUMBER(15)	NOT NULL		last_updated_by NUMBER(15) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);

-continued

Table Definitions

rule_recovery				create table rule_recovery (
rule_recovery_id	NUMBER(15)	NOT NULL	Primary key	rule_recovery_id NUMBER(15) NOT NULL,
rule_header_id	NUMBER(15)		Foreign key: rule_headers.rule_header_id Note: only header OR line id should be specified, NOT both.	rule_header_id NUMBER(15),
rule_line_id	NUMBER(15)		Foreign key: rule_lines.rule_line_id	rule_line_id NUMBER(15),
error_code	VARCHAR2(25)	NOT NULL	Foreign key: ss_lookup_codes. lookup_code, lookup_type= 'RuleError'	error_code VARCHAR2(25) NOT NULL,
solution_id	NUMBER(15)	NOT NULL	Foreign key: solutions.solution_id	solution_id NUMBER(15) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
printer_models				create table printer_models (
printer_model_id	NUMBER(15)	NOT NULL	Primary key	printer_model_id NUMBER(15) NOT NULL,
model	VARCHAR2(25)	NOT NULL		model VARCHAR2(25) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
printers_to_rules			unique by printer_type_id, rule id, sequence_num	create table printers_to_rules (
printer_model_id	NUMBER(15)	NOT NULL	Foreign key: printer_models. printer_model_id	printer_model_id NUMBER(15) NOT NULL,
rule_header_id	NUMBER(15)	NOT NULL	Foreign key: rule_headers.rule_header_id	rule_header_id NUMBER(15) NOT NULL,
sequence_num	POSITIVE	NOT NULL		sequence_num POSITIVE NOT NULL,
active_flag	VARCHAR2(1)	NOT NULL	Can be 'Y' or 'N'	active_flag VARCHAR2(1) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240)
created_by	VARCHAR2(20)	NOT NULL		created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL		creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL		last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL		last_update_date DATE NOT NULL);
link_text				create table link_text (
link_text_id	NUMBER(15)	NOT NULL	primary key	link_text_id NUMBER(15) NOT NULL,
link_text	VARCHAR2(100)	NOT NULL		link_text VARCHAR2(100) NOT NULL,
description	VARCHAR2(240)			description VARCHAR2(240),

-continued

Table Definitions			
created_by	VARCHAR2(20)	NOT NULL	created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL	creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL	last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL	last_update_date DATE NOT NULL);
(NEW)			create table (NEW)(
created_by	VARCHAR2(20)	NOT NULL	created_by VARCHAR2(20) NOT NULL,
creation_date	DATE	NOT NULL	creation_date DATE NOT NULL,
last_updated_by	VARCHAR2(20)	NOT NULL	last_updated_by VARCHAR2(20) NOT NULL,
last_update_date	DATE	NOT NULL	last_update_date DATE NOT NULL);

[**0046**] Table 3 shows the data lookup types and codes for the exemplary Rules Engine.

Data Lookup Type	Description
RuleAction	Action types for rules
RuleError	Error types when rules don't work as expected
RuleOperator	Instructions for comparing usage profile parameters
RuleValueType	Instructions for determining what aspects of a UP parameter to evaluate
SolutionStatus	Status codes for solutions (returned to calling modules)
Units	Measurements (day, month, year, etc.)
UPInterface	Status codes for the UP Interface table
ErrorLevel	Error codes for solutions, other to help determine how processing should continue.

Lookup Type	Lookup Code	Description
RuleAction	NextLine	Go to next line within same rule
RuleAction	NextRule	Go to next rule
RuleAction	Solution	Return the Solution
RuleAction	SkipToLine	Skip to Rule Line number indicated (within the same rule)
RuleAction	SkipToRule	Skip to Rule Header number indicated (for same printer type)
RuleAction	RuleStop	Stop processing further rules.
RuleAction		
RuleError	LineNotFound	Action was "NextLine", but no more lines available
RuleError	RuleNotFound	Action was "NextRule", but no more Rules available
RuleError	EvalFailure	Unable to evaluate Usage Profile Parameter(s)
RuleError	HeaderLoop	Encountered endless loop through rule headers due to rule misconfiguration
RuleError	LineLoop	Encountered endless loop through rule lines due to rule misconfiguration
RuleError	TimedOut	Time limit exceeded: possible endless loop or system failure.
RuleError	TokenNotFound	A rule line asked for a token number that could not be found in the current UP record
RuleError	SolutionNotFound	A rule line asked for a solution_id that doesn't exist in the solutions table.
RuleError		
RuleOperator	DateAfter	Date occurs on or after comparison value
RuleOperator	DateBefore	Date occurs on or before comparison value
RuleOperator	DateBetween	Date occurs between comparison value (list of 2)
RuleOperator	DateEquals	Date equals comparison value (to nearest time unit specified)
RuleOperator	ItemEquals	String or number equals the comparison value
RuleOperator	MatchCount	String or number pattern found multiple times in token payload
RuleOperator	NumBetween	Number is between comparison values (list of 2)
RuleOperator	NumGreaterThan	Number greater than the comparison value
RuleOperator	NumAccumulate	Add the numeric result from this token value to the running total (no comparison with another value yet)
RuleOperator	NumLessThan	Number less than the comparison value
RuleOperator	TimeBetween	Time interval between comparison value (list of 2, and to nearest time unit specified)

-continued

RuleOperator	TimeEquals	Time interval equals comparison value (to nearest time unit specified)
RuleOperator	TimeGreaterThan	Time interval greater than comparison value (to nearest time unit specified)
RuleOperator	TimeLessThan	Time interval less than comparison value (to nearest time unit specified)
RuleOperator	WithinPayload	Comparison value (string or number) found within the token payload
RuleOperator	WithinValue	String or number found within the comparison value (delimited list)
RuleOperator		
RuleOperator		
RuleValueType	Constant	A fixed number or text value
RuleValueType	NamedValue	Specific token payload value, identified by its key (name portion of the name:value pair)
RuleValueType	PayloadSum	The sum of all values from that name:value pairs in a token payload.
RuleValueType	TokenValue	A value from the token payload where name:value pairs are not a factor.
RuleValueType	RunningTotal	The accumulated sum of several token values gathered in prior rules
RuleValueType	Ignore	Ignore this value (used to skip evaluating a primary or secondary value when incrementing the other in a series of rule lines)
Units	Seconds	
Units	Minutes	
Units	Hours	
Units	Days	
Units	Weeks	
Units	Months	
Units	Years	
Units		
SolutionStatus	Positive	Solution represents certain diagnosis of problem from Usage Profile data.
SolutionStatus	Indeterminate	Unable to determine with certainty the nature of the problem from the Usage Profile data.
SolutionStatus	RuleFailure	A rule failed, and this solution came from the Rule Recovery table.
SolutionStatus		
SolutionStatus		
UPInterface	Error	Error processing for interface
UPInterface	Loading	Records are still loading - don't post yet
UPInterface	Posted	Records are posted to UP database
UPInterface	Purge	Records can be purged
UPInterface	Ready	Indicates records are ready to post
UPInterface		
ErrorLevel	Normal	Processing ended normally
ErrorLevel	Warning	Processing ended with warning-level errors
ErrorLevel	Fatal	Processing ended with fatal errors
ErrorLevel		

[**0047**] Referring to **FIG. 6**, the relationships between the various entities in the Rules Engine is described. For each printer model **200**, there is a list of printer rules **202**. Each rule includes a header **204**, which is used to access the rule lines **206**. Rule lines **206** are operated on by actions, operators, value types and time units **212** reference lookup codes **216** which reference lookup types **214** to generate solutions **210**. Solutions **210** reference text link **218**.

[**0048**] The overall process flow of the Rules Engine is shown in **FIG. 7**. Upon receipt of a support request, the Rules Engine sets up a Session_id and stores the received Usage Profile text in memory (step **220**). The run status is initialized to normal (step **222**). The Rules Engine then parses the Usage Profile record (such as the one shown in Table 1) into a format shown in Table 3 and stores the tokenized result in Usage Profile database **116** (step **224**).

[**0049**] Table 4 shows a the User Profile of Table 1 after it has been parsed into individual components or tokens, a token value or payload assigned to each component and the components stored in the User Profile database **116**.

Token	Token Description	Token Payload
1	Date of Report	Thu Nov 16 17:43:47 2000;
2	Activation Date	Mon Oct 23 23:25:59 2000;
3	Printer IDs	Serial #:BCLP356, Ethernet:08:00:11:0F:01:33, IP:13.62.70.236, —:xxxxxx;
4	Printer Name	Steffen's_BC;
5	Printer Type	Model:Phaser 860DP, Printer Class:Solid Ink;
6	Adobe Firmware	3010.108 (11);

-continued

Token	Token Description	Token Payload
7	Xerox Firmware	VxWorks:3.18, Engine:14.20, PostScript:14.18, Network:12.48.10.18.2000;
8	Installed RAM (MBs)	128;
9	Installed Trays (incl. Manual)	3;
10	Accessories	Duplexer, , ,;
11	Current Media	Upper Tray:Transparency-Letter, Middle Tray:—, Lower Tray:Paper-Letter, Manual Feed:Other-Other;
101	Report Intervals	Pages:1000, Hours:168;
111	Total Pages & Sheets	Pages:980, Sheets:924;
112	Total Pixels Printed (1K)	Cyan:889005, Magenta:1089088, Yellow:475571, Black:1029656;
113	Average Coverage (%)	Cyan:6, Magenta:7, Yellow:3, Black:8;
114	Coverage-Last 1000 Pages (%)	Cyan:6, Magenta:7, Yellow:3, Black:8;
115	Ink Consumed (Sticks)	Cyan:0.90481, Magenta:1.08198, Yellow:0.50879, Black:1.15476;
116	Pixels Printed Cyan (1K)	Fast Color:10453, Standard:588447, Enhanced:2436, High-Resolution/Photo:287669;
117	Pixels Printed Magenta (1K)	Fast Color:13880, Standard:651569, Enhanced:3615, High-Resolution/Photo:420024;
118	Pixels Printed Yellow (1K)	Fast Color:10831, Standard:371417, Enhanced:2694, High-Resolution/Photo:90629;
119	Pixels Printed Black (1K)	Fast Color:22223, Standard:944578, Enhanced:2454, High-Resolution/Photo:60401;
121	Paper vs. Transparency (pages)	Paper:939, Transparency:41, Other:0;
122	Pixels Printed-Paper (1K)	Cyan:798613, Magenta:974505, Yellow:425226, Black:708775;
123	Coverage-Paper (%)	Cyan:5, Magenta:6, Yellow:3, Black:5;
124	Pixels Printed-Transparency (1K)	Cyan:90392, Magenta:114583, Yellow:50345, Black:320881;
125	Coverage-Transparency (%)	Cyan:16, Magenta:20, Yellow:9, Black:56;
131	Color vs. Black & White (pages)	Color:821, Black & White:156, Blank:3;
132	Pixels Printed-Black & White (1K)	Cyan:0, Magenta:0, Yellow:0, Black:85608;
133	Coverage-Black & White (%)	Cyan:0, Magenta:0, Yellow:0, Black:4;
134	Pixels Printed-Color (1K)	Cyan:889005, Magenta:1089088, Yellow:475571, Black:944048;
135	Coverage-Color (%)	Cyan:7, Magenta:8, Yellow:4, Black:8;
141	1-Sided vs. 2-Sided (sheets)	1-Sided:868, 2-Sided:56;
143	Manual Feed Media (sheets)	Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
144	Cassette Tray Media (sheets)	Upper-Paper-Letter:0, Upper-Paper-Legal:0, Upper-Paper-A4:0, Upper-Transparency-Letter:41, Upper-Transparency-A4:0, Middle-Paper-Letter:0, Middle-Paper-A4:0, Lower-Paper-Letter:883, Lower-Paper-A4:0;
151	Print Quality (pages)	Fast Color:46, Standard:903, Enhanced:3, High-Resolution/Photo:28;
152	Color Correction (pages)	None:1, Vivid Color:0, Simulate Display:2, SWOP Press:0, Euroscale Press:0, Commercial Press:0, Black and White:0, Raw CMYK:20, Raw RGB:0, Automatic:957, Toyo Press:0, Dai Nippon Press:0, Fuji Press:0, Newsprint:0, Non-PostScript:0, Undefined:0;
161	Sets Printed (pages)	First Set Pages:951, Subsequent Set Pages:19;
162	Jobs By Document Length	0–1:132, 2–4:77, 5–9:14, 10–19:8, 20–29:2, 30–49:4, 50–74:2, 75–99:11 100–249:0, 250+:0;
163	Jobs By Number of Sets	0–1:233, 2–4:7, 5–9:0, 10–19:0, 20–29:0, 30–49:0, 50–74:0, 75–99:0, 100–249:0, 250+:0;
164	Pages By Document Length	0–1:141, 2–4:233, 5–9:77, 10–19:112, 20–29:48, 30–49:159, 50–74:120, 75–99:80, 100–249:0, 250+:0;
165	Pages By Number of Sets	0–1:940, 2–4:30, 5–9:0, 10–19:0, 20–29:0, 30–49:0, 50–74:0, 75–99:0, 100–249:0, 250+:0;
171	Job Source	Internal:5, EtherTalk:0, Parallel:14, USB:0, FrontPanelJobInput:7, AppSocket:220, FTP:0, LPR:0, Remote Internet Printing:0, TokenTalk:0, PrintServer:0, IPP:3, Other:0;

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Token	Token Description	Token Payload
172	Job Language	PostScript:241, PCL:0, AutoSelect:0, Scanner:0, PDF:0, Other:0;
173	Jobs Collated	No:241, Yes:0;
174	Time Per Job (mins)	0–1:217, 2–3:13, 4–9:10, 10–29:0, 30–59:0, 60+:0;
175	Total Jobs	Printing Jobs:241, Non-Printing Jobs:8;
176	Cancelled Jobs	3;
181	Days Printed	24;
182	Pages Per Day	0–1:7, 2–4:1, 5–9:1, 10–24:2, 25–49:7, 50–99:3, 100–249:3, 250–499:0, 500–999:0, 1000+:0;
183	Power On Count	6;
184	Time On Distribution (hours)	0–1:1, 2–3:0, 4–9:0, 10–23:3, 24–167:0, 168+:1;
185	Days Since Activation	23;
186	Hours Since Last Power On	345;
187	Total Time On (hours)	569;
188	Power Off Page#	0, 0, 3141, 3142, 3366;
189	Power Off Date Log	—, —, Wed Oct 25 15:05:34 2000, Wed Oct 25 15:08:26 2000, Wed Nov 01 17:55:55 2000;
191	Total Warmup Time (hours)	1;
192	Total Offline Time (hours)	0;
193	Total EnergyStar Time (hours)	0;
194	EnergyStar Time Distribution (mins)	0–14:0, 15–29:0, 30–119:0, 120–299:0, 300–599:0, 600+:0;
201	JetStack StandBy Time (hours)	28;
202	JetStack StandBy Time Distribution (mins)	0–14:5, 15–29:0, 30–119:30, 120–299:0, 300–599:0, 600+:0;
203	StandBy Time (hours)	373;
204	StandBy Time Distribution (mins)	0–14:3, 15–29:1, 30–119:3, 120–299:0, 300–599:1, 600+:17;
221	Maintenance Kit Installation Date	Wed Aug 09 07:39:13 2000;
222	Maintenance Kit Remaining (%)	59;
223	MKIC	4354;
224	Maintenance Kit Consumption Rate	Low:0, Medium:0, High:980;
231	Doors Open	Front Cover:6, Exit Cover:0, Top Cover:2;
232	Supplies Replaced	Ink-Low:0, Ink-Empty:0, Maintenance Kit-Low:0, Maintenance Kit-Empty:0, Other:0;
233	Paper Out	Upper Tray:2, Middle Tray:0, Lower Tray:10;
234	Button Presses	328;
235	Feature	Info Button:4, Supplies Info Menu:1, Network Setup Menu:0, Printer Setup Menu:0, Job Defaults Menu:0, Printable Pages Menu:10, Service Pages Menu:0, Support Menu:3, Printer Identification:6, Improve Print Quality?:1, Network Questions?:0, Resolve Paper Jams:0, Service Tools Menu:0, TroubleShoot Jams:0;
237	Printer Status	0, 10, 0, 6, 9, 6, 10, 0, 10, 0, 10, 0, 10, 0, 18;
251	System Reset Count	0;
252	System Reset Log	0, 0, 0, 0, 0;
253	System Reset Page#	0, 0, 0, 0, 0;
254	System Reset Date Log	—, —, —, —, —;
261	Engine Error Count	0;
262	Engine Error Log	—, —, —, —, —, —, —, —, —, —, —, —, —, —, —;
263	Engine Error Page#	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0;
264	Engine Error Date Log	—, —, —, —, —, —, —, —, —, —, —, —, —, —, —;
265	Jam Error Count	10;
266	Jam Error Log	—, —, —, —, —, —, —, —, —, —, 22,705.07, 22,024.01, 22,024.01, 22,024.01, 22,500.00;
267	Jam Error Page#	0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2164, 2199, 2614, 2826, 3001;

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Token	Token Description	Token Payload
268	Jam Error Date Log	—, —, —, —, —, —, —, —, —, —, Thu Oct 12 11:45:36 2000, Thu Oct 12 13:42:32 2000, Wed Oct 18 12:04:43 2000, Fri Oct 20 09:31:24 2000, Tue Oct 24 18:34:47 2000;
271	PostScript Error Count	0;
272	PostScript Error Log	0, 0, 0, 0, 0;
273	PostScript Error Page#	0, 0, 0, 0, 0;
274	PostScript Error Date Log	—, —, —, —, —;
280	Print Head Auto Clean Source	PowerUp:0, EnergyStar:0;
281	PrintHead Clean Count	Automatic:0, Manual:0;
282	PrintHead Clean Source	—, —, —, —, —, —, —, —, —, —;
283	PrintHead Clean Page#	0, 0, 0, 0, 0, 0, 0, 0, 0, 0;
284	PrintHead Clean Date Log	—, —, —, —, —, —, —, —, —, —;
285	PrintHead Installation Page#	0, 0, 0, 0, 0, 0, 0, 0, 0, 2938;
286	PrintHead Installation Date Log	—, —, —, —, —, —, —, —, —, Mon Oct 23 23:25:59 2000;
287	PrintHead Purge Count	Cold Purge:0, Warm Purge:0, High Voltage Cold Purge:0, High Voltage Warm Purge:0;
291	Last Jam Location	—, —, —, —, Jam D;
292	Last Jam Media Tray	—, —, —, —, Upper Tray;
293	Last Jam Media	—, —, —, —, Upper-Paper-Letter:;
294	Last Jam Page#	0, 0, 0, 0, 3001;
295	Last Jam Date Log	—, —, —, —, Tue Oct 24 18:35:06 2000;
296	Last Jam Transfix Speed	—, —, —, —, 5IPS;
301	Jam A (Upper Tray)	Upper-Paper-Letter:0, Upper-Paper-Legal:0, Upper-Paper-A4:0, Upper-Transparency-Letter:0, Upper-Transparency-A4:0;
302	Jam B (Middle/Lower Trays)	Middle-Paper-Letter:0, Middle-Paper-A4:0, Lower-Paper-Letter:0, Lower-Paper-A4:0;
303	Jam C (Exit Cover)	Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
304	Jam D (Front Cover)	Paper-Letter:1, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
305	Jam E (Exit Tray)	Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
307	Jam Manual Feed	Paper-Letter:0, Paper-Legal:0, Paper-A4:0, Transparency-Letter:0, Transparency-A4:0, Other:0;
331	JetStack PF Count	7;
332	JetStack PF Hours	267.97;
333	JetStack PF Log	0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 35.77, 78.21, 14.59, 17.16, 19.02, 83.11, 20.09;
334	JetStack PF Date Log	—, —, —, —, —, —, —, —, —, Fri Oct 27 15:09:57 2000, Tue Oct 31 09:02:49 2000, Mon Nov 06 09:02:29 2000, Wed Nov 08 09:03:55 2000, Fri Nov 10 09:04:32 2000, Tue Nov 14 09:25:16 2000, Thu Nov 16 09:25:54 2000;
335	JetStack PF Page#	0, 0, 0, 0, 0, 0, 0, 0, 3198, 3243, 3463, 3490, 3591, 3671, 3880;
401	Diagnostic Result #0	ID:23,TS:6,PC:3806,Thu Nov 02 2000,08:21:28,R0:180.0000,R1:180.0000,R2:180.0000,R3 :0.0 000,R4:180.000;
402	Diagnostic Result #1	ID:23, TS:6, PC:2663, Thu Oct 12 2000, 16:32:57, R0:180.0000, R1:180.0000, R2:180.0000, R3:0.0 000, R4:180.000;
403	Diagnostic Result #2	ID:23, TS:6, PC:2635, Thu Oct 12 2000, 13:42:02, R0:180.0000, R1:180.0000, R2:180.0000, R3:0.0 000, R4:180.000;
404	Diagnostic Result #3	ID:23, TS:6, PC:2635, Thu Oct 12 2000, 13:39:10, R0:180.0000, R1:180.0000, R2:180.0000, R3:0.0 000, R4:180.000;
405	Diagnostic Result #4	—;
406	Diagnostic Result #5	—;

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Token	Token Description	Token Payload
411	WarmUp Mode	Intelligent Ready;
412	Adaptive Data Sun	—, —; —, —, —;
413	Adaptive Data Mon	—, —, —, —, —, —, —, —, 2, 2, 2, 2, —, —, 3, 3, 3, 3, 2, 3, 3, —, —, —, —;
414	Adaptive Data Tue	—, —, —, —, —, —, —, —, —, 2, 2, 3, 2, —, 3, 3, —, —, 1, —, —, —, —, —;
415	Adaptive Data Wed	—, —, —, —, —, —, —, —, —, 2, 1, 3, —, 3, —, 3, —, 3, 2, —, —, —, —, —;
416	Adaptive Data Thu	—, —, —, —, —, —, —, —, 2, 3, 3, 3, 2, 2, 3, —, —, 3, —, —, —, —, —, —;
417	Adaptive Data Fri	—, —, —, —, —, —, —, —, —, 3, —, 2, 2, 1, 3, 3, 3, 2, 2, —, —, —, —, —;
418	Adaptive Data Sat	—, —;
419	Warmup Setting	Sun :−1, Mon :−1, Tue :−1, Wed :−1, Thu :−1, Fri :−1, Sat :−1;
420	Standby Setting	Sun :−1, Mon :−1, Tue :−1, Wed :−1, Thu :−1, Fri :−1, Sat :−1;
1001	Profile Error Count	3;
1002	Profile Error Log	0, 0, 127, 101, 117;
1003	Profile Error Page#	0, 0, 3001, 3001, 3415;
1011	Page Count Trigger	500;
1012	Time Trigger (hours)	84;
1013	Jam Count Trigger	5;
1021	Polling Interval	2;
1022	Email on First Jam	0;
1023	Restart Count Trigger	5;
1031	Pages From Engine	Usage Profile:970, Total Pages:3908;
1033	Verification State	0xc0;
1034	Recent Coverage Page Setting	1000;
1035	Supplies Replaceable Interval	2, 60;
1036	Total Percent Coverage (pages)	0–9:512, 10–24:303, 25–49:44, 50–99:27, 100–199:94, 200+:0;

[0050] The Rules Engine identifies the model of printer from the value in token 5, which in this case is a Phase Model **860** (step **226**). To facilitate operation on the various token values, the usage profile records (table 4) are written to an interface table, stored in memory (step **228**). Next, all rules in the rules database are analyzed sequentially, using data from the usage profile record. Each rule is retrieved based on its particular rules header (step **230**).

[0051] Table 5 lists the Data Rule Headers for the exemplary Rules Engine.

rule_header_id	name	symptom
257	Currently Cleaning for Light stripes (maybe for Ink Smears, but unlikely)	28128: Light Stripes - Faded or White Lines or Streaks
258	Light Stripes in Last 15 Minutes	28128: Light Stripes - Faded or White Lines or Streaks
259	Light Stripes in Last 4 Days - Without an automatic dean following it.	28128: Light Stripes - Faded or White Lines or Streaks
260	Current Jam Message	Any Jam
261	Jam in Last 15 Minutes	Any Jam
262	3 Jams in Last 4 Days	Any Jam

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rule_header_id	name	symptom
263	Ink Use Message and Energy Star or Auto Cleans	33329: The Printer Consumes more Ink than Anticipated
264	Frequent Recent Auto Cleans	33329: The Printer Consumes more Ink than Anticipated
265		
266	Current Fault Code	Any Service Fault
267	Fault in Last 15 Minutes	Any Service Fault
268	Fault in Last 4 Days	Any Service Fault
269		
270	Currently Cleaning for Ink Smears	28297: Marks, Smudges, or Scratches
271	Recent Cleaning for Ink Smears	28297: Marks, Smudges, or Scratches
272		
273	Hasn't Used Driver Features	26085: Cannot get the Printer to do Automatic Duplex or Two-Sided Printing

[0052] Each rule header identifies a particular rule line, which contains the ruler header id, the rule line id, rule line number, value type, token number, token name, parameter number, payload key, parameters to search, operator, comparison value, action true (what to do if the action is true,

i.e., go to a solution or the next rule) and action false (go to the next rule or in some cases a solution). Each rule tells the rules engine how to process particular values of user profile information to determine a solution, which is identified by a solution ID. The solution ID will be shown in the action true or action false columns in Table 5. For example, rule header id **266**, current fault code, has a symptom of any service fault. Rule **266** in Table 6 has a value type of token, which means a token value from the usage profile data must be obtained. The token number is 262 and the name is engine error log., which has a parametric value of −1. The operator is "itemequals" and the action if true is to escalate to a field call. If false, go to the next line of the rule.

[**0053**] Table 6 lists the rule lines for the exemplary rules engine.

rule header id	rule line id	rule line num	value type	token num	token name	parm num	pay-load key	parms to search	operator	action true	action false
257	2046	1	TokenValue	237	Printer Status	−1			ItemEquals	NextLine	NextRule
257	2047	2	TokenValue	237	Printer Status	−3			ItemEquals	NextLine	Solution
257	2048	3	TokenValue	282	PrintHead Clean Source	−1			ItemEquals	NextLine	NextRule
257	2049	4	TokenValue	284	PrintHead Clean Date Log	−1			TimeLessThan	Solution	NextRule
258	2050	1	TokenValue	282	PrintHead Clean Source	−1			ItemEquals	NextLine	NextRule
258	2051	2	TokenValue	284	PrintHead Clean Date Log	−1			TimelessThan	Solution	NextRule
259	2052	1	TokenValue	282	PrintHead Clean Source	−1			ItemEquals	NextLine	NextRule
259	2053	2	TokenValue	284	PrintHead Clean Date Log	−1			TimelessThan	Solution	NextRule
259	2054	3	TokenValue	282	PrintHead Clean Source	−2			ItemEquals	NextLine	NextRule
259	2055	4	TokenValue	284	PrintHead Clean Date Log	−2			TimelessThan	Solution	NextRule
260	2056	1	TokenValue	237	Printer Status	−1			WithinValue	Solution	NextRule
260	2057	2	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextRule
260	2058	3	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextRule
260	2059	4	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextRule
260	2060	5	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
260	2061	6	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
260	2062	7	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
260	2063	8	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	Solution
261	2064	1	TokenValue	268	Jam Error DateLog	−1			TimeLessThan	NextLine	NextRule
261	2065	2	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2066	3	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2067	4	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2068	5	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2069	6	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2070	7	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
261	2071	8	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	Solution

-continued

rule header id	rule line id	rule line num	value type	token num	token name	parm num	pay-load key	parms to search	operator	action true	action false
262	2072	1	TokenValue	268	Jam Error Date Log	−3			TimeLessThan	NextLine	NextRule
262	2073	2	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2074	3	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2075	4	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2076	5	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2077	6	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2078	7	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	NextLine
262	2079	8	TokenValue	266	Jam Error Log	−1			ItemEquals	Solution	Solution
263	2080	1	TokenValue	237	Printer Status	−1			WithinValue	NextLine	NextRule
263	2081	2	TokenValue	282	PrintHead Clean Source	−1		6	MatchCourt	NextLine	NextRule
263	2082	3	TokenValue	284	PrintHead Clean Date Log	−3			TimeLessThan	NextLine	NextRule
263	2083	4	TokenValue	284	PrintHead Clean Date Log	−1			TimeLessThan	NextLine	NextRule
263	2084	5	NameValue	280	Print Head Auto Clean Source		Energy Star		NumGreater-Than	Solution	Solution
264	2085	1	TokenValue	282	PrintHead Clean Source	−1		6	MatchCourt	NextLine	NextRule
264	2086	2	TokenValue	284	PrintHead Clean Date Log	−3			TimeLessThan	NextLine	NextRule
264	2087	3	TokenValue	284	PrintHead Clean Date Log	−1			TimeLessThan	NextLine	NextRule
264	2088	4	NamedValue	280	Print Head Auto Clean Source		Energy-Star		NumGreater-Than	Solution	Solution
265	2089										
266	2090	1	TokenValue	237	Printer Status	−1			ItemEquals	NextLine	NextRule
266	2091	2	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	NextLine
266	2092	3	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	Solution
267	2093	1	TokenValue	264	Engine Error Date Log	−1			TimeLessThan	NextLine	NextRule
267	2094	2	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	NextLine
267	2095	3	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	Solution
268	2096	1	TokenValue	264	Engine Error Date Log	−1			TimeLessThan	NextLine	NextRule
268	2097	2	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	NextLine
268	2098	3	TokenValue	262	Engine Error Log	−1			ItemEquals	Field-Escalate	Solution
269	2099										
270	2100	1	TokenValue	237	Printer Status	−1			ItemEquals	NextLine	NextRule

-continued

rule header id	rule line id	rule line num	value type	token num	token name	parm num	pay-load key	parms to search	operator	action true	action false
270	2101	2	TokenValue	237	Printer Status	−3		3	MatchCount	NextLine	NextRule
270	2102	3	TokenValue	284	PrintHead Clean Date Log	−1			TimeLessThan	NextRule	Solution
271	2103	1	TokenValue	237	Printer Status	−1			ItemEquals	NextLine	NextRule
271	2104	2	TokenValue	237	Printer Status	−3			ItemEquals	NextLine	NextRule
271	2105	3	TokenValue	284	PrintHead Clean Date Log	−1			TimeLessThan	NextRule	Solution
272	2106										
273	2107	1	NamedValue	151	Print Quality (pages)		Fast Color		NumIncrement	NextLine	NextLine
273	2108	2	NamedValue	151	Print Quality (pages)		En-hanced		NumIncrement	NextLine	NextLine
273	2109	3	NamedValue	151	Print Quality (pages)		Photo		NumIncrement	NextLine	NextLine
273	2110	4	RunningTotal						NumLessThan	Solution	NextLine
273	2111	5	NamedValue	143	Manual Feed Media (sheets)		Transparency Letter		NumIncrement	NextLine	NextLine
273	2111	6	NamedValue	143	Manual Feed Media (sheets)		Transparency A4		NumIncrement	NextLine	NextLine
273	2111	7	RunningTotal						NumGreater-Than	Solution	NextLine
273	2112	8	NamedValue	152	Color Correction (pages)		Auto-matic		NumLessThan	Solution	NextLine
273	2113	9	TokenValue	10	Acces-sories				WithinPayload	NextLine	NextRule
273	2114	10	NamedValue	141	1-Sided vs. 2-Sided (sheets)		2-Sided		NumLessThan	Solution	NextRule

[0054] Referring back to **FIG. 7**, suppose a particular rule returned a solution instead of a next line indication. Table 7 lists the solutions by solution id. Referring to Table 7, and with reference to step **232**, the error level in column 4 of table 7 is checked first. The lookup error recovery solution is determined (step **242**) and the solution is then appended to the list of information to be sent to the user in response to his service request (step **250**). In step **260**, the error level is checked to see if it is either normal, warning or fatal. If fatal, the rules engine sets the status to fatal (step **266**), and adds the parameters to the solution id list and run status (step **268**) and the rule engine analysis ends (step **270**). If the solution is normal, the rules engine checks to see if more rules have to be evaluated (step **264**). If not, the rules engine adds the parameters to the solution id list and run status (step **268**) and the rule engine analysis ends (step **270**). If more rules are to be run, it returns to step **230**. If the error is a warning, the rules engine sets the run status to warning (step **262**) and goes to step **264**.

TABLE 7

Data Solution

solution id	name	status code	error level	description
100	Default LineNotFound	RuleFailure	Warning	Default solution for rule failure: Line Not Found
101	Default RuleNotFound	RuleFailure	Warning	Default solution for rule failure: Rule Not Found

TABLE 7-continued

Data Solution

solution id	name	status code	error level	description
102	Default EvalFailure	RuleFailure	Warning	Default solution for rule failure: Evaluation Failure
103	Default HeaderLoop	RuleFailure	Fatal	Default solution for rule failure: Header loop
104	Default LineLoop	RuleFailure	Fatal	Default solution for rule failure: Line loop
105	Default TimedOut	RuleFailure	Fatal	Default solution for rule failure: Time out
106	LightStripes Failure	RuleFailure	Warning	Specific solution for light strips rule failure
107	Critical NextLine Failure	RuleFailure	Fatal	For critical nextline failures
108	Field Escalate (General)	Positive	Normal	General field escalation solution
109	Printer jam, general (860): 01	Positive	Normal	Printer jam solution
110	Printer jam, general (860): 02	Indeterminate	Normal	Printer jam solution
111	Printer jam, general (860): 03	Positive	Normal	Printer jam solution
112	Printer jam, general (860): 04	Indeterminate	Normal	Printer jam solution
113	Printer jam, general (860): 05	Indeterminate	Normal	Printer jam solution

[0055] If the result of step **232** indicates there is no error, the rules engine retrieves the next rule line (step **234**) and checks for an error at step **236**. If yes, it continues to step **242**. If not, at step **238**, usage profile token value from table 4 is compared with the token value for the rule. The two values are compared in step **240**. If the match is true, the true action line from the rule line (step **246**) is selected. If the match is false, the false action line from the rule line is selected (step **248**). If there is an error in the match, the rules engine goes to step **242**. In step **252** the action type is determined. If it is a solution, the rules engine goes to step **250**. If it says to go to the next line or skip to a particular line it goes to that line and returns to step **234**. If the action type is next rule or skip to rule it goes to step **230**.

[0056] The invention has been described with reference to a particular embodiment. Modifications and alterations will occur to others upon reading and understanding this specification taken together with the drawings. The embodiments are but examples, and various alternatives, modifications, variations or improvements may be made by those skilled in the art from this teaching which are intended to be encompassed by the following claims.

What is claimed is:

1. A support system for diagnosing printer problems, comprising:

a support server having a rules engine for parsing printer diagnostic data into components, for analyzing the components and for generating a suggested solution based on combinations of printer diagnostic data and error conditions; and

at least one printer, located remote from the support server, wherein the printer includes a printer driver, responsive to a request for support, for communicating with the support server;

wherein, responsive to a request for support from the printer, the printer transmits printer diagnostic data to the support server;

wherein, the rules engine parses and analyzes the printer diagnostic data and generates a suggested solution and the support server transmits the suggested solution to the printer.

2. The system of claim 1, wherein the support server and the printer communicate over the Internet.

3. The system of claim 1, wherein the support server further includes a printer diagnostics utility; wherein responsive to a request for support from the printer, the support server transmits the printer diagnostics utility to the printer; and wherein, upon receipt of the printer diagnostics utility, the printer generates printer diagnostic data.

4. The system of claim 1, wherein the printer driver further includes a usage profile utility for generating and storing usage information and printer status information during operation of the printer and wherein, responsive to the request for support from the printer, the printer transmits the usage profile information and printer status information to the support server.

5. The system of claim 2, wherein the printer further comprises a web browser for pointing to a web page at the support server.

6. The system of claim 2, wherein the printer further comprises a web server for generating web pages pertaining to the printer.

7. The system of claim 6, wherein the printer and the support server communicate over the Internet via a web browser;

wherein the printer driver further includes a usage profile utility for generating and storing usage information and printer status information during operation of the printer; and

wherein, responsive to the request for support from the printer, the web server attaches the usage profile information and printer status information to a web page for the printer and transmits the web page to the support server.

8. The system of claim 1, wherein the printer has a unique identifier and wherein the support server further comprises a memory for storing historical information pertaining to the printer comprising a record of the request for support, the printer diagnostic data and the suggested solution.

9. The system of claim 8, wherein the support server transmits historical information to the printer.

10. The system of claim 8, wherein the support server verifies warranty information for the printer.

11. The system of claim 2, wherein, the printer further comprises a processor, a memory storing a web browser and an input/output device having a display.

12. The system of claim 1, wherein the printer is coupled to an input/output device for receiving user requests for support and for displaying received solutions.

13. The system of claim 12, wherein the input/output device comprises a personal computer.

14. The system of claim 12, wherein the input/output device comprises a wireless device.

15. The system of claim 12, wherein the input/output device comprises a processor, a memory and a front panel display in the printer.

16. The system of claim 1, wherein on receipt of the suggested solution, the printer executes the suggested solution.

17. A support system for diagnosing printer problems, comprising:

a support server having a rules engine for parsing printer diagnostic data into components, for analyzing the components and for generating a suggested solution based on combinations of printer diagnostic data and error conditions; and

at least one printer, located remote from the support server, wherein the printer includes a printer driver, responsive to a request for support, for communicating with the support server, a usage utility for generating and storing printer diagnostic data during operation of the printer, wherein printer diagnostic data comprises usage profile information and printer status information, and a web server for generating web pages pertaining to the printer;

wherein, responsive to a request for support, the printer driver loads a web browser, the web browser accesses a web address associated with the printer and invokes the web server, the web server generates a web page containing any stored usage profile information and printer status information and transmits the stored printer diagnostic data to the support server;

wherein, the rules engine parses and analyzes the printer diagnostic data and generates a suggested solution and the support server transmits the suggested solution to the printer.

18. A method of remotely diagnosing printer problems in a support system having a support server and at least one printer located remote from the support server, comprising:

sending a request for support from the printer to the support server;

transmitting printer diagnostic data to the support server;

using a rules engine to parse the printer diagnostic data into components and to analyze the components;

generating a suggested solution based on combinations of printer diagnostic data and error conditions; and

transmitting the suggested solution to the printer.

19. The method of claim 18, wherein the support server and the printer communicate over the Internet.

20. The method of claim 19, wherein the printer includes a printer driver having a web browser for pointing to a web page at the support server and wherein the step of sending a request for support from the printer to the support server comprises accessing the web browser.

21. The method of claim 18, wherein prior to sending a request for support, generating printer diagnostic data at the printer during operation of the printer and storing the user profile information and printer status information at the printer.

22. The method of claim 21, wherein the printer diagnostic data comprises usage profile information and printer status information.

23. The method of claim 18, wherein subsequent to transmitting the request for support, transmitting a printer diagnostic utility from the support server to the printer; and using the printer diagnostic utility to generate printer diagnostic data.

24. The method of claim 18, further comprising storing historical information pertaining to the printer comprising a record of the request for support, the printer diagnostic data and the suggested solution at the support server.

25. The method of claim 24, further comprising transmitting stored historical information to the printer.

26. The method of claim 18, further comprising verifying warranty information for the printer.

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